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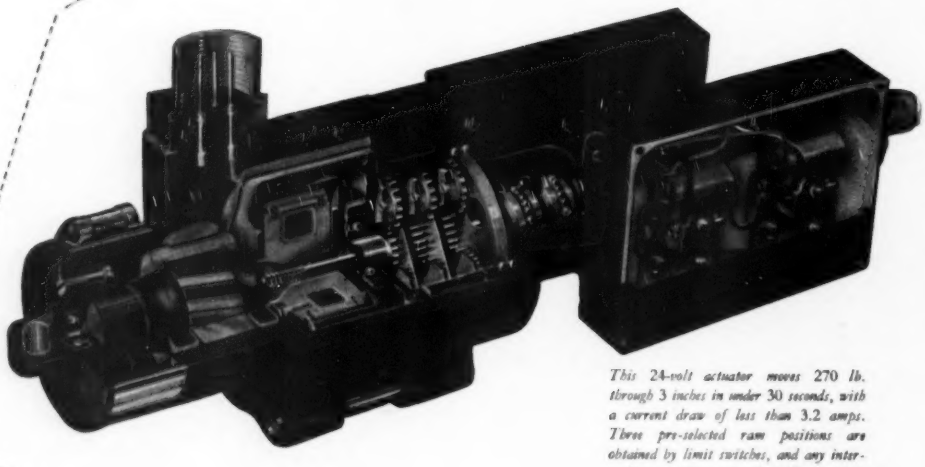

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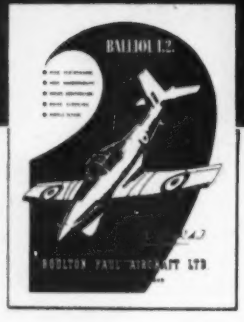

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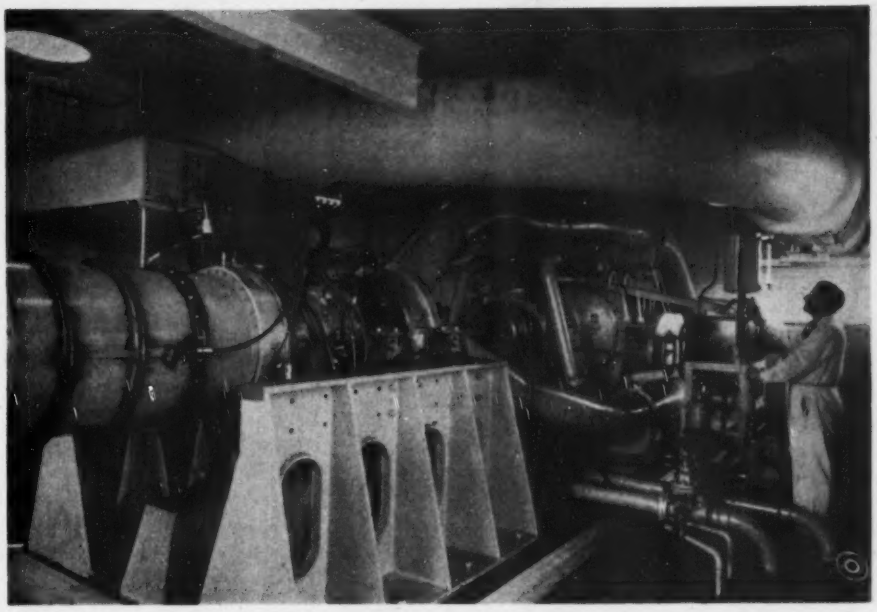

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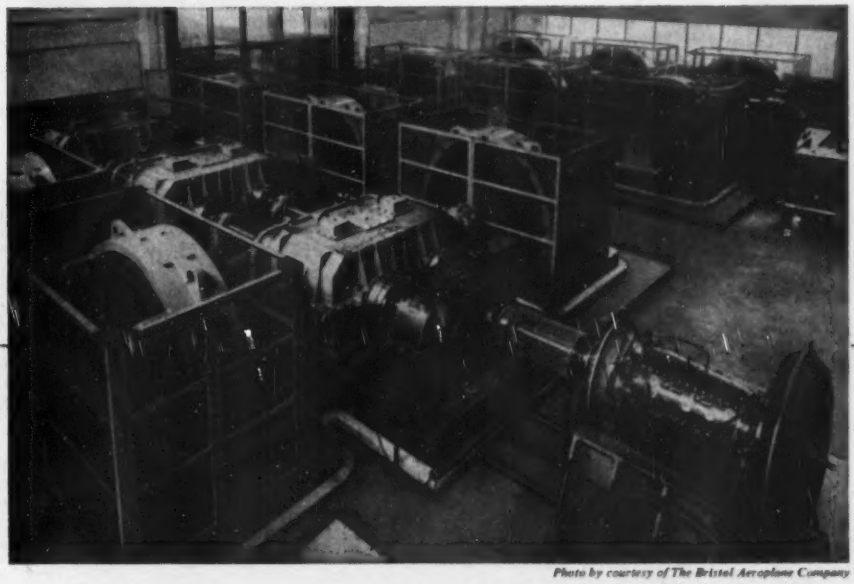

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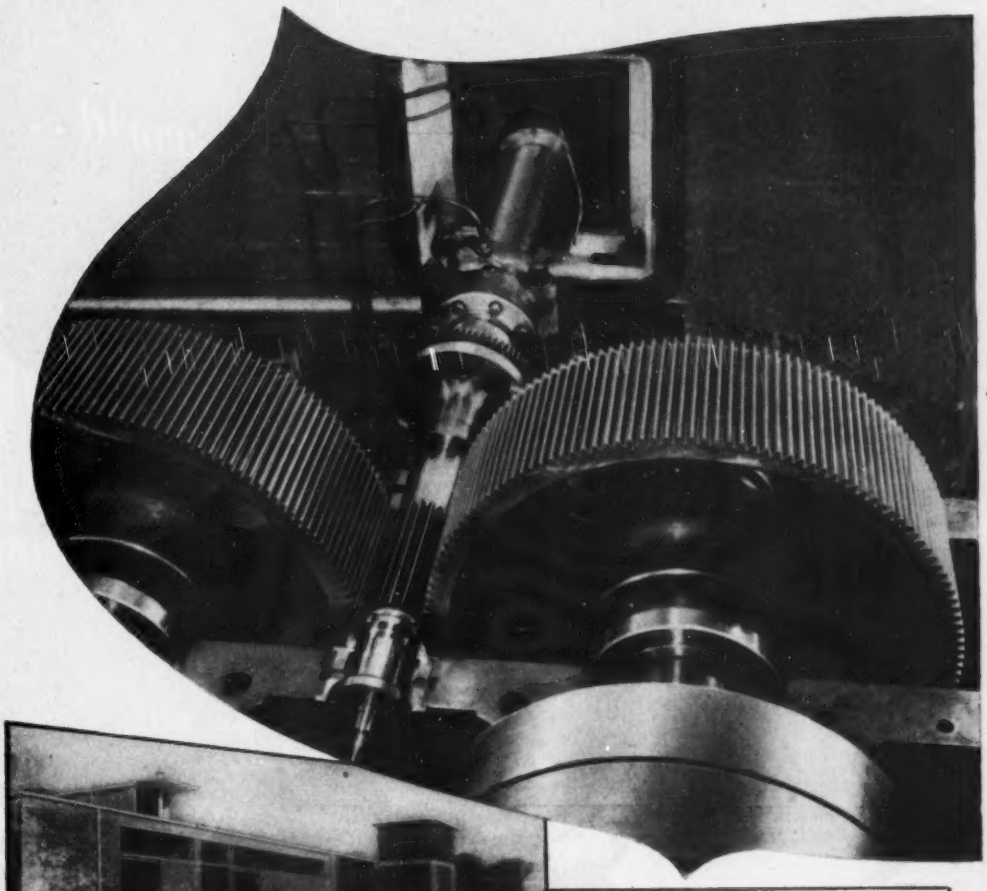

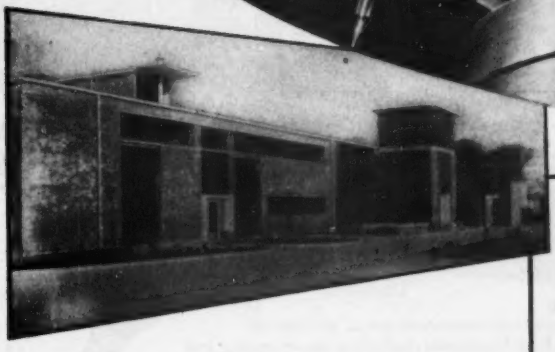

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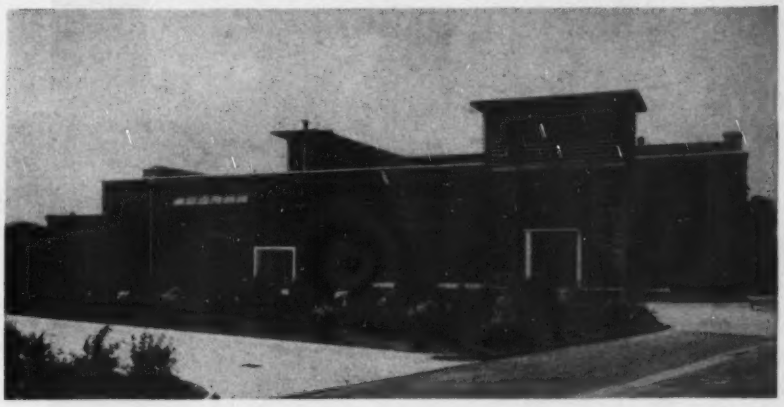

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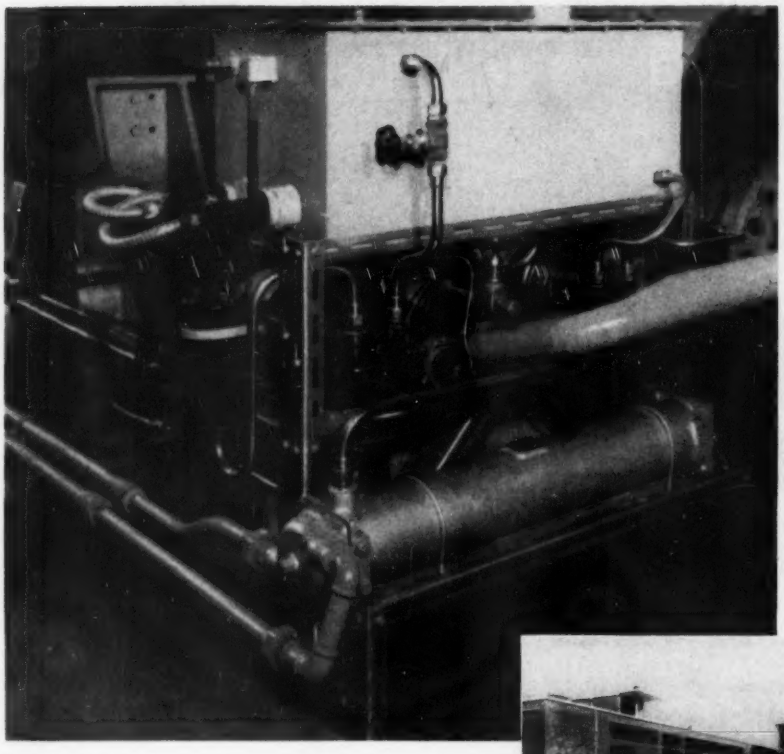

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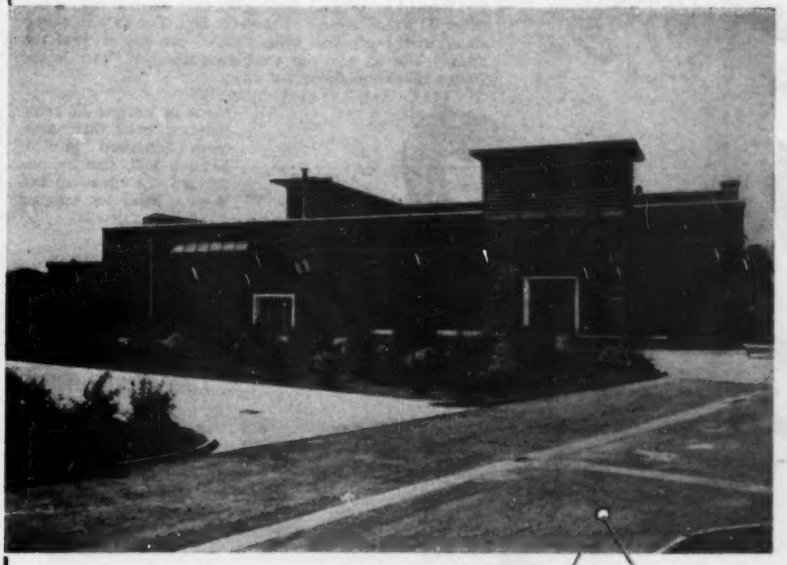

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What a pity he spurned the practice of wiser aeronauts and refused to fit "Jac" Spring Washers beneath nut. They never let a man down . . . however far! For all who swoop about in the cerulean blue, "Jac's" the boy to beat the jitters! For all who put aeroplanes together, "Jac" is the washer that keeps them that way.

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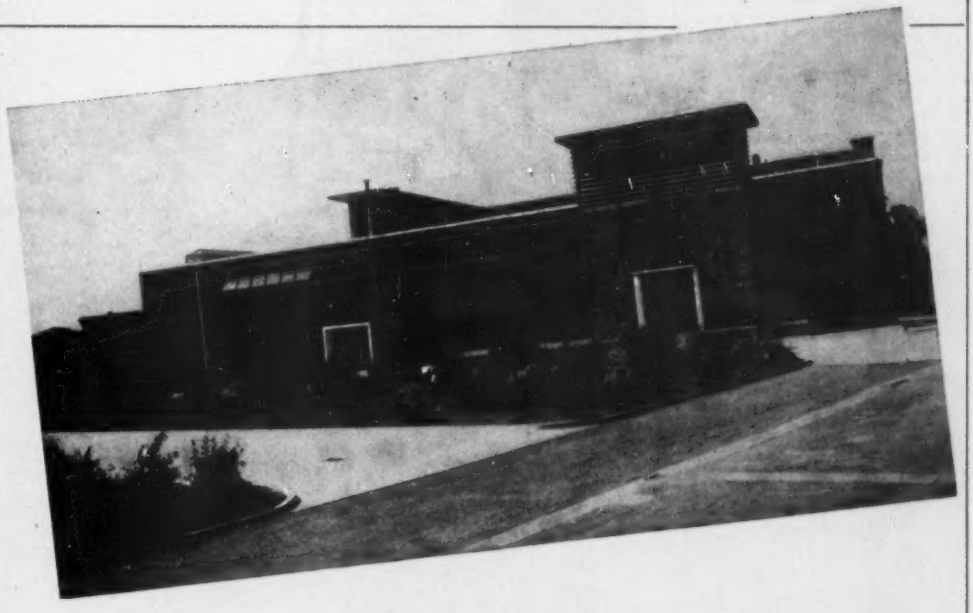

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Founded 1909

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Normal and Special Services

WRITTEN into their aims, objects or charters, many airlines have words to the effect that they will maintain the highest standards and, consistent with economy, seek to increase and improve their services to meet public needs. The first days of the month of May, 1952, will long be remembered for the great innovations which have occurred in furtherance of such pledges. Air-coach, tourist or high-density services, as they are variously called, have become a reality on the all-important North Atlantic route and, for first-class passengers, the first jet airliners have commenced operating to and from South Africa. Both moves represent only the beginning of world-wide route patterns of low-fare and luxury jet services.

In a recent issue, *Flight* recorded with admiration the outstanding achievement of the de Havilland Enterprise in designing and producing the Comet and its power units, and the foresight and skill of British Overseas Airways Corporation in bringing these remarkably high-speed aircraft into public service on May 2nd. Here we turn to the introduction of international low-fare services—a matter of parallel importance in bringing air travel within the grasp of many thousands, perhaps millions, more people.

In 1950 over 31 million passengers were carried by the world's airlines; last year the figure was 39 million, and in the current year at least a similar percentage increase is expected. Last year's figure of 340,000 Atlantic air passengers may be doubled in 1952. Although no more than a start has been made with low-fare services, albeit on an international basis, the well-worn clichés concerned with making the world smaller and nations neighbours acquire a new meaning. Individuals or families with only fourteen-day summer holidays now have a chance to see something of the world. The cost of air travel is still very high—the new Atlantic single fare is £96—but a substantial reduction has been made from the £141 of last year.

World operators are almost unanimous in their agreement that the introduction of low-fare services is timely. A few have said that, because of the financial difficulties in which most European nations find themselves, because of the possibility of a slump round the corner, and particularly because of the rising costs faced by the airline companies, the introduction may be premature. But an immense and rapidly expanding airline organization already exists throughout the world, and the sooner the advantage of air travel can be extended to new strata of the peoples the better it must be for all. Some operators will have fleet difficulties, for new aircraft of the right sort, required for passenger services and freighting as well, are very difficult to procure. It is no mean task, moreover, to cut fares when costs are rising.

Timely, costly, difficult or not, for the first time regular flying services have started to be offered reasonably cheaply to the ordinary family rather than being virtually restricted to the well-breeched or those travelling on business.

Misleading Terms

British airlines have long appreciated the importance of names and slogans. Whatever description may be adopted for low-fare services in other countries, we should remember that ordinary people will react to the mental picture conjured up by the name. We may recall the world's first named air service, reintroduced this week by B.E.A.—the always popular Silver Wing London-Paris service first flown by Argosies 25 years ago. On the other hand, "high-density," "third-class," "tourist" and similar terms should be avoided, suggesting as they do austerity, congestion, and even discomfort.

Standard, comfortable transatlantic services in large modern aircraft are what the airlines now have to offer, and at new, more reasonable, fares. B.O.A.C. has given the name Mayflower to its new service in this category. It is, we believe, the first-class services to which we have grown accustomed which should now be regarded as out of the ordinary.

Everything now depends upon the continued expansion of traffic and on the public maintaining its increasing desire to use the air. The growth in air traffic, especially low-fare services, within the United States—regarded by many people as a good guide to developments elsewhere—has been remarkable. The signs are favourable.

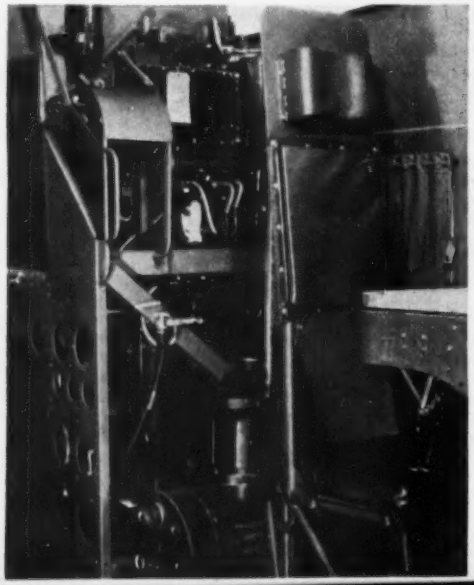
Marathons—Military and Civil

Details of the R.A.F. Crew Trainer: West African and Burmese Versions

THE R.A.F. have reason to congratulate themselves on the acquisition of 30 Marathons for aircrew training. To be able to purchase new aircraft off the shelf is indeed exceptional these days, and to get what appears to be a thoroughly suitable design in this way, and to have been spared all the usual birth-pangs and teething troubles as well, is something truly remarkable.

One reads that juvenile delinquency is frequently the result of a broken home and the unwanted child, but while commercial operators have perhaps been slow to appreciate the Handley Page Marathon, and its upbringing and development have been interrupted on more than one occasion, it is by no means unwanted—it was, in fact, eagerly adopted—and shows no signs whatever of delinquency.

Now that the R.A.F. have spoken for thirty Marathons, and West African Airways Corporation have ordered four at once and two more to follow, certain other operators, ready to follow a strong lead, are showing renewed interest. But for the time being the cupboard is bare, Union of Burma Airways having taken the remaining three aircraft of the first and completed production batch. The delivery picture might change should the R.A.F., for example, order more Marathons as a result of experience with their first examples in service. Its capacity, speed, modernity, four-engined safety and ability to operate from small strips all give the aircraft commercial appeal.



The Marathon in the heading photograph is a standard production machine with Service markings, and is being used for trials until the first R.A.F. aircraft is ready. Above is the mock-up layout of navigators' tables and equipment in the roomy interior. Below left, one of the 25g rearward-facing seats, and behind it an indication of the accessibility of the navigators' equipment, the units of which are shown in the plan (right).

Of late there has been a requirement for two kinds of crew trainer or flying classroom in the R.A.F., one to look after the more elementary exercises and another for advanced work. For many years past, the perennial Anson has been used in the former case, and recently Valettas and Varsities have served for the latter purpose. (An article on No. 201 Advanced Flying School, which is equipped with these two Vickers types, appeared in *Flight* of April 25th.) The R.A.F. needs more of this kind of aircraft at once but cannot have them; so they have turned to the Marathon as being capable of meeting most requirements for both intermediate and advanced training.

Should it prove possible to do all the work with one aircraft of under 20,000 lb a.u.w. this would seem to be an economical approach to future planning. The makers' belief that the Marathon can, in fact, do the work very satisfactorily has given rise to the hopes of a repeat order.

MARATHON DATA

(Four D.H. Gipsy Queen 70s: 345 h.p. for take-off)

Span	65ft
Length	52ft 1in
Height	14ft 1in
Wing area	498 sq ft
All-up weight	18,000 lb
Wing loading	36.1 lb/sq ft
Max. speed at 6,750ft	232 m.p.h.
W.M. cruise at 5,000ft	200 m.p.h.
" " at 10,000ft	209 m.p.h.
" " at 14,500ft	196 m.p.h.
Rate of climb (max. weight), 4 engines	683ft/min
" " " " 3 "	246ft/min
Absolute ceiling	18,000ft
Take-off run (18,000 lb)	560 yd
" " to 50ft	1,030 yd
Landing, from 50ft	790 yd
Cabin length (civil version)	18ft
" mean height	6ft 2in
" width	7ft 9in
" capacity	760 cu ft

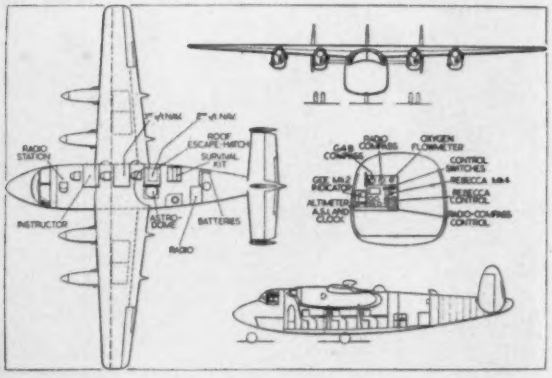
Recently the Secretary of State for Air, Lord De L'Isle and Dudley, V.C., accompanied by Air Marshal Sir Hugh S. P. Walmsley, K.C.I.E., C.B., C.B.E., M.C., D.F.C., A.O.C.-in-C. Flying Training Command, visited Woodley Aerodrome, Reading, to inspect the Marathons. They were escorted by Sir Frederick Handley Page, C.B.E., and by A. Cdre. A. V. Harvey, C.B., M.P., who is a director of the company.

Another aircraft in the running, which has already found favour with the Navy, is the Percival Prince (or Sea Prince as the variant is called) and a development of the design, under consideration by the R.A.F. for crew training as well as its other rôles, has been named Pembroke.

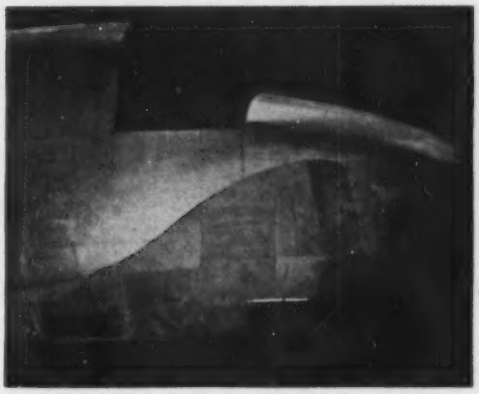
The modifications required for R.A.F. Marathons are not of a major kind; they amount mainly, as one would expect, to an interior refit.

The engines, de Havilland Gipsy Queen 70/3s, are retained for the R.A.F. Marathons, and in order to give adequate range for the new duties, fuel tankage of 410 gallons is being provided. Four main-wing tanks carry 216 gallons; two new tanks in the outboard engine nacelles hold 130 gallons; and the four standard overload tanks in the wings contain 60 gallons. This is sufficient for an extreme range of 1,400 miles, or 7½ hours' duration at weak mixture cruising. This meets the requirement of five-hour training flights, and the Marathon can also cruise at 15,000ft as called for in the provisional specification, oxygen being provided in R.A.F. versions.

Several combinations of crew are possible, and the accompanying plan indicates the seating arrangements, which, subject to confirmation, will be standard for R.A.F. machines. It will be seen that there are stations for a first (or staff) pilot, second pilot, radio operator, navigational instructor, 1st u/t. navigator and 2nd u/t. navigator. In addition, a "gash bod" might be carried for special exercises or experience. The second pilot could be u/t. for four-engined experience or revision, or the seat could be left empty. For some training work the 1st u/t. navigator might navigate the aircraft and the instructor could then be a w/op., and the w/op.'s station be occupied by a pupil.



G.A. drawing and interior arrangement of the R.A.F. Marathon.



Mock-up of a proposed bomb aimer's station under the Marathon nose. This may possibly be adopted as a retrospective modification.

It is expected that the following equipment will be carried: Gee, Rebecca, radio compass, twin V.H.F., 1154-55 M.F., astro-compass, sextant, radio altimeter, G.4B compass and, when available, I.L.S. with Zero Reader. Two separate intercom systems are to be installed so that instruction can proceed without interfering with flying instructions or vice versa. Four generators are fitted.

Detail differences externally visible will be blister windows beside each of the u/t. navigators' stations, and an astro-dome near the entrance door. A possible retrospective mod. is a bomb-aimer's position which would be faired into the underside of the nose on the starboard side. It would be entered through a hatch in place of, or near to, the second pilot's seat. The window nearest to the main door will be hinged to allow a camera to be used for pin-point and turning-point identification.

The navigators' desks are of the large Varsity-type and their seats face backwards and are stressed for 25g. The usual R.A.F. emergency kit is carried, and the escape hatches and doors as provided for civil Marathons are retained.

Pilots will notice several changes in the R.A.F.-type instrument panel (the flexible coaming is retained), and a full cross-feed fuel system is now provided. The earlier manual arrangements have been replaced by electric fuel-cocks.

Deliveries with all changes incorporated are due to begin on July 1st. One machine will go to Boscombe again for examination, although the aircraft as such was passed out many months ago. Another will go to a navigational training unit for appraisal. Three aircraft are to be delivered in August, three in September and three in October, and afterwards at four per month. During this period West African and Burma aircraft are also to be delivered.

We may add here some brief details about the civil versions. W.A.A.C. are having increased fuel-tankage up to 350 gallons (i.e., they will have no overload tanks), while U.B.A. will have the full capacity of 410 gallons. Both types will have Gipsy Queen 70/4 engines, but, as in the R.A.F. version, reversing airscrews are considered unnecessary. A special ventilation system is installed for tropical climates, and the heaters are omitted.

W.A.A.C. are making provision for a crew of two only in their first four aircraft—captain and 2nd officer/radio operator—while U.B.A. will carry a crew of three with separate radio operator in their three aircraft.

The Marathon is the sort of aircraft that pilots like, and Boscombe's handling reports were good. Roominess, excellent view out and four-engined safety are all qualities which we believe will lead to popularity in the R.A.F.

FROM ALL QUARTERS

"Flight" photograph

HISTORIC MOMENT: The first production D.H. Comet (G-ALYP, flagship of the B.O.A.C. fleet) leaves London Airport on the inaugural service to Johannesburg. The journey began at 3 p.m. (local time) on May 2nd and ended less than 24 hours later. The departure is described on the page opposite.

Trans-Australian Viscounts

CONFIRMATION is now to hand of the report quoted in *Flight* last week that the State-owned Trans-Australia Airlines have placed an order for Vickers Viscounts. The number is, however, six and not five, as previously announced, and the value of the order is approximately £1½ million. It is intended that deliveries shall start in 1954.

Thus, to Australia falls the distinction of being the first country outside Europe to equip with turboprop aircraft. Vickers-Armstrongs, Ltd., point out that the distances between the principal Australian cities are such as to make possible valuable economies in operating costs as well as improving passenger comfort and speeding up schedules.

The Australian decision now brings the total number of Viscounts on order to 42: B.E.A. are to have 20 (and possibly an additional quantity), Air France 12, and Aer Lingus 4. The first production machine is due for delivery to B.E.A. in October this year.

Sabre Paces Hunter

THREE of America's most distinguished test pilots have been visiting this country on a "familiarization" mission to fly our finest military aircraft. Heading the party was General Albert Boyd, senior test pilot of the U.S.A.F. and for many years chief test pilot at Wright Field. He is now vice-chief of the Wright Air Development Centre and his log book contains every recent type of U.S.A.F. aircraft and many foreign machines as well, including the Marcel Dassault Mystère. With him were Lt. Col. Richard Johnson, a fighter test pilot and holder of the world's speed record of 670.981 m.p.h. (this he established in a Sabre as long ago as September 15th, 1948) and Col. Fred Ascani, a bomber test pilot and chief of the Bomber Flight Test Section.

Observed by General Jack Wood, the U.S. Air Attaché, and by other officials from the American Embassy, the visiting pilots flew from Dunsfold in pairs—one in the Hawker Hunter, a second in an F-86. Radio contact was maintained and the Hunter was paced by the American fighter. Each pilot took a turn at the controls of each aircraft and a joint report will be submitted to the American authorities.

The chief test pilots from all the companies of the Hawker Siddeley Group attended a dinner given by the Group for the visitors. Before returning home the American pilots also flew the D.H.110.

Encouraging Ultra-Lights

AS a result of the great interest being shown in the R.Ae.C. light aeroplane design competition, it has been decided, with the support of the Kemsley Flying Trust, to extend the scope of the competition to include two further designs—for a single-seat racing aeroplane and for a single-seat aerobatic machine. First, second and third prizes of £100, £50 and £25 will be awarded for winning designs in all three sub-divisions of the competition. In the specification for the racing aircraft, a take-off weight of less than 1,102 lb is stipulated, whereas the aerobatic design must not exceed 700 lb. Use of British power-plants is compulsory. Designers requiring further particulars of the competition should apply immediately to the Secretary-General, the Royal Aero Club, 119 Piccadilly, London, W.1. Those who have already entered the

NEW WORLD LOOKS TO OLD: Left, at Glosters to see the G.A.5 are (l. to r.): A. Cdre. M. Costello (Canadian Joint Staff Commission); E. W. Shambrook, F.C.I.S. (director and secretary); W. G. Carter, C.B.E., F.R.Ae.S. (technical director); P. G. Crabbe, F.R.Ae.S., M.I.P.E. (newly appointed managing director); R. W. Walker, F.R.Ae.S. (chief designer); W. A. Waterton, A.F.C. and bar (chief test pilot); Air Marshal W. A. Curtis (Chief of Air Staff, R.C.A.F.); R. V. Atkinson (director); Eric Greenwood, O.B.E., A.F.R.Ae.S. (technical sales manager); S/L. J. T. MacKinnon, Staff Officer to Air Marshal Curtis. Right, on the Hawker occasion described on this page ("Sabre Paces Hunter") are seen General Albert Boyd (dark glasses, dark overalls); Lt. Col. Richard Johnson (white overalls, facing camera), S/L. Neville Duke (extreme left), and Mr. Neville Spriggs (side face).

MEETING IN TOKYO: Air Marshal J. D. I. Hardman, C.B., O.B.E., D.F.C., Chief of Staff, Royal Australian Air Force, called on General Weyland, Commanding General Far East Air Force, during a brief inspection of airfields in Japan and Korea. The two officers are seen in conversation at the General's Tokyo H.Q.

THIRSTY WORK: Seen in place on a production-type Boeing B-47B are the largest external tanks ever mounted on an aircraft. They are painted in a bizarre pattern of black and white, in order that they may be identified during drop tests. The gross weight of the B-47B is announced as "almost 93 tons." Six General Electric J-47-23s are fitted.

two-seat lightplane competition are not required to make any further application and should use their allotted number in submitting designs for the new competitions.

New Gloster Managing Director

MR. P. G. CRABBE, F.R.Ae.S., M.I.P.E., has been appointed managing director of the Gloster Aircraft Co., Ltd., partly in recognition of his work with the Gloster team in producing the Meteor, and partly, in the words of Mr. Hugh Burroughes (deputy managing director of the Hawker Siddeley Group), "because the Hucclecote factory has work of even greater significance coming to it." Mr. Burroughes added that he was now empowered to say officially that before Meteor production comes to an end, Glosters will turn over to the super-priority job of making the Hawker Hunter. He went on, "Most of this task will be carried out by Hawkers, but the various sections of the Hawker Siddeley Group always 'carry the ball' for one another; and an important proportion of the work on the Hunter will be handled by Glosters. I cannot, at present, say when this work will begin. We all hope, too, that in the near future a decision will be taken by the Government to order the G.A.5, the fine new Gloster delta fighter. This is another Crabbe achievement and a production programme for this will naturally mean even more responsibility for him."

Sealands for India

FROM Belfast comes the excellent news that Short Brothers and Harland, Ltd., have received an order from the Office of the High Commissioner of India for ten Sealand amphibians for the Indian Navy. They will be powered with Gipsy Queen 70-4 engines, which give a higher continuous output for cruising than the generally used 70-3 type. Long-range tanks will be installed and in a separate station in the forward cabin, designed to facilitate training, will be STR 9X, AD/7092A and AD107/94 radio. Dual controls are specified and accommodation will be provided for pilot, co-pilot, observer and three passengers. There is also a toilet compartment.

The Sealands will be based at Cochin, on the western seaboard of Southern India.

COMET ON SCHEDULE

B.O.A.C. Opens the World's First Jet Service

THE scene is London Airport; the time is 1445 hr local time on May 2nd, 1952. Airliners of many nations crowd the apron, their cabin-tops white against an inky sky. Among them, out of sight of the many observers at windows and on terraces, is B.O.A.C.'s de Havilland Comet G-ALYP. Today it carries for the first time fare-paying passengers. With the full complement of 36 installed, and his initial cockpit checks completed, Capt. A. M. Majendie, Flight Captain of the Comet Fleet, is ready to start the four Ghost turbojets. Now the shrill jet-song drowns the background hum of piston-engines and heat-haze floats away across the airport. Promptly, at 1500 hr, chocks are pulled away and the Comet turns towards the taxi-track, gleaming brightly in a sudden burst of sunshine. Twelve minutes later, climbing swiftly away from No. 5 runway in a wake of thunderous sound (inaudible near the terminal buildings), the flagship of B.O.A.C.'s Comet Fleet is airborne for Rome.

So began the first scheduled jet flight to Johannesburg, where the Comet arrived 23 hr 38 min later—two minutes ahead of schedule. "It went without a hitch," said Sir Miles Thomas, who had joined the aircraft at Livingstone. The flight, he said, had "put British civil aviation—jet-propelled—on the map of the world." Speaking before departure on behalf of the three crews who made the flight, Capt. Majendie had said simply: "We are very glad to have the honour of launching this service . . . We are also very proud to be using this *British* aeroplane."

No official ceremony was held to mark the Comet's departure; the moment was considered to be historic in itself. Among the watching crowds were many of those who had made the event possible—including Sir Geoffrey de Havilland, Mr. R. E. Bishop, Mr. R. M. Clarkson, Maj. Frank Halford, Mr. J. L. P. Brodie, Dr. E. S. Moult and G/C. John Cunningham. B.O.A.C.'s representatives included Mr. Whitney Straight, Mr. John Booth, Sir Francis Brake, Mr. A. C. Campbell-Orde and Capt. M. J. R. Alderson. It was regrettable, as many remarked, that A. Cdre. Sir Frank Whittle was not present.

Capt Majendie had expected headwinds on the first leg of the flight, and the Comet was in fact nine minutes late when it landed at Rome at 1646 G.M.T. On the Rome-Beirut stage, however, lost time was regained, and the aircraft averaged 525 m.p.h. with the aid of a tailwind. The remainder of the journey proceeded to plan, with slip-crews taking over at Beirut and Khartoum. For the inaugural service it was particularly essential to adhere to the schedule, and Capt. Alabaster "killed time" on the Livingstone-Johannesburg leg by leaving late and making wide turns. At 1438 hr B.S.T. on May 3rd, the Comet touched down at Palmietfontein, Johannesburg, where it received a great welcome from some 20,000 South Africans. Passengers were reported to be "without the slightest sign of fatigue." The Comet's return journey began at 0737 hr B.S.T. on Monday and ended with the arrival at London Airport on Tuesday morning at 0740 hr B.S.T.

For the Record—Crews and Complement

On the inaugural outward flight, the following passengers left London Airport, the majority having booked through to Johannesburg: Mr. A. Henshaw (first "jet passenger" to be booked), Mr. J. S. Crossley, Mr. D. Carter, Brig. G. Ross, Mr. A. O. Cookman, Mr. P. F. Knight, Mr. R. D. Gwyther, Mr. E. T. Pinkney, Mr. J. Garlick, Mr. W. K. Peters, Mr. P. Straffa, Mr. D. P. Bertlin, Miss D. Hannaford, Mr. S. C. Brealey, Dr. J. M. Brown, Col. E. P. J. Ryan, Mr. W. E. Lawson, Mr. G. N. Wright, Mr. B. I. D. Jackson, Mr. L. Morris, Mr. R. Brook, Mr. C. H. Briesh, Ald. J. H. Wemsley, Mr. D. Willis, Mr. Fraser Wighton, Mr. G. W. Pearson, Mr. W. A. Walker, Mr. G. Movshon, Mr. E. C. Bailey, Mr. O. Garlick, Miss A. Coleridge-Taylor, Mr. T. West, Mr. A. C. Hales, Mr. B. Hardy, Mr. L. Orton and Mr. S. Naude.

The flight was made by the following members of the B.O.A.C. Comet Fleet: London-Rome-Beirut: Capt. A. M. Majendie, F/Off. J. G. Woodill, Eng/Off. W. L. Bennett, Rad/Off. R. W. Chandler, Steward E. W. Charlwood, Stewardess J. P. Nourse.

Beirut-Khartoum: Capt. J. T. A. Marsden, D.F.C., F/Off. K. Emmott, Eng/Off. T. W. Taylor, Rad/Off. G. L. Coutts, Steward A. C. McCormack, Stewardess E. P. Courtney.

Khartoum-Entebbe-Livingstone-Johannesburg: Capt. R. C. Alabaster, D.S.O., D.F.C., F/Off. D. T. Whitham, F/Off. (supernumary) B. A. Arterton, Eng/Off. J. A. Johnson, Rad/Off. R. J. Dolman, Steward T. D. Irwin, Stewardess A. Cartmell.

HERE AND THERE

ASPECT RATIO 32.5: While the two Hurel-Dubois HD.31 twin-engined freighters are being assembled at Villacoublay, the experimental HD.10 has continued with test-flying. Recently this machine, seen above, flew to N. Africa where it will shortly give demonstrations at Oran and Casablanca. From all accounts, it is a very efficient aircraft.

Dutch Hunters or Swifts?

ACCORDING to an Amsterdam report the Dutch Minister of War has stated that Holland is likely to expand her air power by the purchase of either the Hawker Hunter or Vickers-Supermarine Swift.

Super-priority and Airliners

THE grant of super-priority for the production of fighter aircraft should have "no significant effect" on the delivery dates of civil transport aircraft, said Mr. Duncan Sandys, Minister of Supply, in reply to a question from Mr. Frank Beswick in the Commons on April 21st.

Up from the Country

GREAT was the surprise of Londoners—especially as little has been heard of the machine for many months—when the graceful Armstrong Whitworth A.W.52 tailless research aircraft, powered by two Rolls-Royce Nenes, was observed orbiting over the West End on April 29th. Ministry of Supply comment: "A routine test flight from Farnborough."

Aircraft Unwelcome

IT is understood that there will be no facilities for landing private aircraft at Silverstone tomorrow, May 10th, when the *Daily Express* Trophy motor race meeting is to be held.

Reminder for Racing Pilots

THE R.Ae.C. reminds intending entrants for the National Air Races (Newcastle-upon-Tyne Airport, July 11th-12th) that entries close on May 19th—i.e., in ten days from now.

AIR COMMERCE

NEXT WEEK'S issue of *Flight*, dated May 16th, will be an enlarged special issue, the Commercial Aviation Number. Among other features will be included a review of the principal aircraft now in service with the world's airlines; a guide, in handy reference form, to operating companies, their fleets, routes, and background; and special messages from airline chiefs of many countries.

Belated

THE airship *Bournemouth* is now expected to make its first long flight at the end of June, according to Mr. A. Leith, secretary of the Airship Club. It was originally scheduled to fly during the Festival of Britain last year, but modifications to the fins after two test-flights have resulted in long delays. Ten members of the Airship Club at Bournemouth are undergoing theoretical instruction in the hope of getting practical flying experience when the dirigible gets into the air. After three weeks at Bournemouth the ship will move to other parts of the country.

A New Payen Design

A FLYING-WING aircraft designed by the unconventional French designer, M. Payen, is reported to be undergoing wind-tunnel testing at Chalais-Meudon. If static testing is successful, flight testing may begin this year. Little is known of the design except that it is powered by a Turboméca turbojet.

Czech Jet Production

THE Czech Minister of Defence, M. Cepicka, has disclosed that Czechoslovakia is building jet aircraft. He said, "Jet planes can only be produced by countries with highly developed industries. Czechoslovakia is capable of such production and, with the aid of Russia, is turning out the best planes in the world."

Lady Whitten-Brown

WITH regret we have to record the death of Lady Whitten-Brown, widow of Sir Arthur Whitten-Brown, navigator to Sir John Alcock on the first direct Atlantic flight. Lady Whitten-Brown, who was 56, died in a Swansea nursing home. She married Sir Arthur in 1919, the year of the Atlantic crossing.

Prince Bernhard in America

SPEAKING as guest of honour at a New York dinner of the Society of Automotive Engineers recently, Prince Bernhard of the Netherlands said that a large part of Europe's aircraft production capacity was standing idle and should be used immediately for the manufacture of aircraft and spares to U.S. orders. "If the Italians can make unbeatable motor cars, why should they not be able to make aircraft that would also be winners?" the Prince asked. "And what about the French—has the source of their brilliant designing capacity dried up? Not likely! And with a name in aviation like Tony Fokker, would the Dutch give up the fight? Not likely, either! In the future the Germans will be at it again and we all know what they can do."

NATO PARADE: Thunderjets for Denmark, having arrived by sea at Copenhagen, are towed—still in their protective cocoons—to the Scandinavian Airlines workshops for final assembly. Britain has a share in this particular scene, for the tractors are Fergusons.

"SUPER-PRIORITY"

Both the bombers and two of the latest replacement fighters selected for quantity production under the R.A.F. re-armament programme are powered by Rolls-Royce Avon Engines.

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REAL AND SIMULATED: On the left is seen the tail of an F9F Panther which was successfully brought back to the flight-deck of the carrier U.S.S. "Antietam" by Lt. R. Saturne, U.S.N., after an encounter with Communist flak over Korea. Above is an experiment carried out at Aberdeen Proving Ground, Maryland, to investigate shell-burst effects on aircraft structures. A 38-lb hollow charge of Pentolite was exploded eight feet from the tail of a suspended B-17.

HERE AND THERE...

Records Confirmed

RECENT record-confirmations announced by the F.A.I. include that of S/L. L. C. E. De Vigne's Canberra flight from London to Castel Benito on February 18th, the time for which is now given as 2 hr 41 min 49.5 sec, equivalent to 866.021 km/hr (538.13 m.p.h.). A delayed-opening parachute drop by a Frenchwoman, Mlle. Monique Laroche, is confirmed at 3,622m (11,880 ft) for the free fall.

The B.I.F.

THE 1952 British Industries Fair opened last Monday at Earls Court and Olympia, London, and Castle Bromwich, Birmingham, and remains open until and including Friday next, May 16th. Most of the exhibits of interest to the aircraft industry are in the engineering section at Birmingham (where 1,300 firms are represented), though the plastics and instrument sections, in London, should not be overlooked. A one-hour air link between London (Croydon Airport) and Castle Bromwich (100 yards from the exhibition entrance) is provided by D.H. Doves of Olley Air Service, Ltd., with departures at 0945 hr from Croydon and 1700 hr from Castle Bromwich; the day-return fare is £5 18s. There is no B.I.F. helicopter service this year.

"And I still say that a warship will do more damage than any aeroplane."

Bang On

AN international helicopter competition is to take place in front of the Eiffel Tower in Paris on May 25th under F.A.I. rules. In the event of a tie in the spot-landing section of the contest, the result will be decided by the bursting of small balloons—by the helicopters' landing-gear—pegged to the ground in the alighting-area. The competition is for the Coupe Stemm.

MAKING READY: Messrs. W. H. Lindsey, M.A., F.R.Ae.S. (centre), and W. F. Saxton, M.B.E. (right), respectively chief engineer and technical and works director of Armstrong Siddeley Motors, Ltd., recently visited America to discuss Sapphire production there. They are seen with Mr. Paul A. Pitt, chief development engineer of the Solar Aircraft Co., the San Diego specialists in gas-turbine combustion chambers, burners and related components.

Clearance for Christchurch

THE Minister of Housing and Local Government, Mr. Harold Macmillan, has allowed the appeal by the de Havilland Aircraft Company against a decision of the Hampshire Planning Authority which limited the use of their Airspeed Division's Christchurch airfield to piston-engined aircraft only. At a public inquiry evidence was given by the company that the ban on jets would have a serious effect on their work at Christchurch. In allowing the appeal the Minister said that although the airfield was in a residential area its work was essential and the ban would interfere with it. Jet aircraft were no more dangerous than other types.

IN BRIEF

THE sixth congress of the International Scientific Film Association is to be held in Paris from September 23rd to October 1st. A committee of the British Scientific Film Association is now selecting films for submission to the congress, and would welcome details of suitable productions. The Association's offices are at 164 Shaftesbury Avenue, London, W.1.

* * *

F. J. Edwards, Ltd., specialists in sheet-metal working machinery and machine tools, are to concentrate their stocks in new showrooms at Park Street, Islington, London N.W.1.

* * *

A pioneer in experimental air-to-ground W/T. communication, Mr. R. D. Bangay has completed 50 years' service with Marconi's Wireless Telegraph Co., Ltd. He was appointed foreign manager in 1935.

* * *

A new leaflet from the Morgan Crucible Co., Ltd., gives performance characteristics of the Megistor glass-enclosed resistor recently developed by the company. The resistor covers the range 10^7 to 10^{13} ohms at a voltage up to 300.

* * *

A summer school in programme design for automatic digital computing machines is to be held at the University Mathematical Laboratory, Cambridge, from September 16th to 26th. Details are obtainable from the Secretary to the Board of Extra-Mural Studies, Stuart House, Cambridge.

CANADA'S AIRCRAFT INDUSTRY

The American Influence: Production of Sabres at the Canadair Plants

PART IV

By JAMES HAY STEVENS

THE first two articles in this series (April 4th and 18th) gave the general picture of the Canadian aircraft industry as it is today. The author is now reviewing the activities of the three main constructors, Avro, Canadair, and de Havilland; the first of these three—taken in alphabetical order—was dealt with last week: the present article is about Canadair, Ltd.

THE firm of Canadair, Ltd., is the largest airframe-producing concern in Canada today and the very first impression it gives the visitor is one of tough efficiency. It is a direct subsidiary (although now virtually of equal size and value) of the Electric Boat Company of New London, Connecticut, U.S.A., and it is the American style of production that immediately strikes the Britisher.

Although as it stands at present the company is a post-war organization, its roots go back to 1923, for it was in that year that Canadian-Vickers, Ltd., opened an aviation department and became the first designer and builder of aircraft in the Dominion. In 1942 this company, engaged by then upon numerous large war contracts—including the manufacture of four hundred Canso amphibians—took over management of a new Government factory at Cartierville Airport, Montreal. In 1944, there was a re-organization and Canadair, Ltd., was formed to exploit the facilities at Cartierville, while Canadian-Vickers retired from the aircraft scene. Continuing to operate in the unsettled post-war conditions, the company soon became the largest commercial aircraft producer in Canada. It evolved the DC-4M by combining the DC-4 fuselage with DC-6 wings and undercarriage and Rolls-Royce Merlin power plant, so making a hybrid that was politically, as well as operationally, acceptable to the R.C.A.F., B.O.A.C., T.C.A. and C.P.A. Seventy-one of these excellent airliners were built, as well as many spares for both the DC-4 and the DC-6; some 250 C47/DC-3 conversions were also carried out for air lines all over the world.

Under the astute leadership of its president, John Jay Hopkins, who recognized the potentialities of Canadair, the Electric Boat Co. acquired the Canadair assets in 1947. The company was energetically re-organized, key personnel were brought in from the U.S.A., and production, which had been faltering, was taken in an iron grip, so that the many outstanding orders were largely completed ahead of schedule.

In 1949, the order for Sabres for the R.C.A.F. was placed and the aircraft were actually being completed so quickly that the first deliveries ran into teething troubles that were still unsolved by the parent company. Today, nearly 300 Sabres have been built and, with orders for the R.A.F. and the U.S.A.F. added to the original, output is being stepped up. Sabre production, which is organized on an elaborate moving assembly line, is concentrated in No. 2 Plant—actually the older war-time buildings. In one large hall, all sub-assembly jigs for wing, fuselage and tail feed into the snake-like assembly line. The immense amount of final preparation, pre-flight and post-flight checking which the highly complex Sabre requires are carried out in the other buildings of this plant. Pressed parts, the Fibreglass radar and aerial fairings, and other details are made in bays of No. 1 Plant.

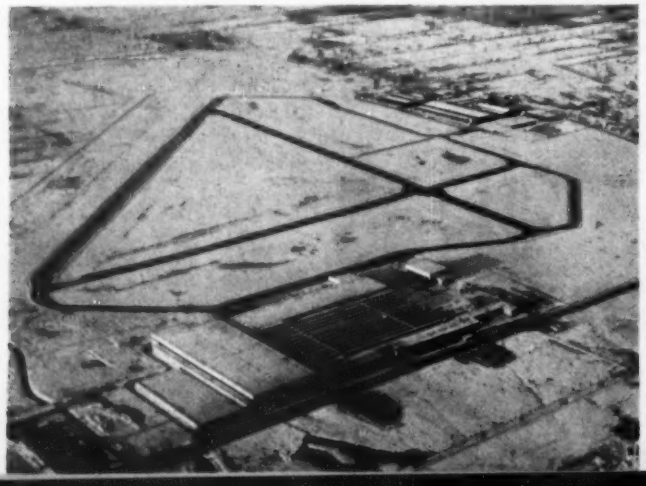
This main factory, which is under one roof in true American style and can be viewed from a catwalk running the entire length, is a very impressive sight. At the time of my visit, it had been enlarged to include a parking lot and a further large end stores bay was to be incorporated as soon as a building across the road had been completed. A lateral addition running the length of the airfield side was also being considered, although this presented some tricky problems in heat loss, since it would include large doors for the exit of complete aircraft.

In this vast No. 1 Plant are all the detail shops, press shops, machine shops and heat treatment shops that feed components to the Sabre line. Here also are made the highly-stressed Sabre drop tanks—orders for which run into thousands for the R.C.A.F. alone—and the DC-3 and DC-4 spares. The floor area is being re-planned to take the T-33 assembly line before the end of this year, to be followed later by that for the T-36.

The machine-tool capacity at Canadair is large; and very striking are the large-capacity hydraulic presses, the 80-ft. spar millers, the 150-ton Hufford stretch-former and, of course, the Cincinnati Hypro-Skin taper mill used for the Sabre wing skins. As in Plant No. 2, the layout of the floor space is planned to bring the completed parts at each stage as closely as possible to the next operation. This concentration upon work flow, where every foot of movement is studied, is quite one of the features of the Canadair factory.

With receipt of the Sabre order, Canadair started an extensive programme of sub-contracting. On that order they have between thirty and forty firms doing machined parts alone. Since they are an approved firm, they are directly responsible for the sub-contractor's work and they provide "lead hands" and foremen to train companies new to aircraft work. The T-33 and T-36 orders (initially 576 of the first and 250 to 300 of the second) have provided a volume of work that has led to much wider sub-contracting, not only of details but of major components as well. For instance, T-33 wings are to be made by Ford at Windsor, apart from fifteen sets coming from the U.S.A. to cover tooling delays; the rear fuselage by Roy Industries of Assumption, P.Q.; and the tail and flying controls by J. H. Connor of Hull, P.Q. These sub-contracted parts will be complete with all systems and wiring ready for final assembly.

It looks as if the 1,700,000 sq ft of factory and 75,500 sq ft of hangarage at Cartierville are going to be pretty well occupied, if not actually overflowing, for the next year or two. In fact there is even a prospect that the CanCar



Cartierville Airport and the two Canadair factories. No. 1 Plant is in the foreground; the large flat roof on the left covers the one-time parking lot and the lower one beside it, at present a store, is soon to form part of the main shop. In the right background is the older No. 2 Plant.

Some of the assembly lines in the Sabre erection hall; the cockpit line on the right moves forward and then backward along the next row until it meets the wings at the back; then it comes forward again.

building on the corner of the airfield may be taken over to meet the ever-increasing demand for space. A further idea of the expansion in hand can be gauged by the anticipated labour increase from the present 8,500 to something like 18,500.

Although the emphasis at Canadair is on production, the company was justifiably proud of its design work on the DC-4M and is out to get orders for its own original layouts. There is a full design team under William K. Ebel, late of Glenn Martin and Curtiss-Wright, which has been engaged on both civil and military project studies. A four-turboprop transport in the 120,000-lb class was dropped because of the future uncertainties of the engine position; but two twin-engined airliners are actually on the board, as well as military studies. The history of the T-36 is interesting too. Within three weeks of receiving the U.S.A.F. specification, Canadair had prepared a design that ranked top in the competition. For various reasons, however, the work was awarded jointly to Beech and Canadair; the Beech design was accepted as the basis, but detail design aft of the main spar has been given to the Canadair D.O., and production orders are, of course, divided between the two firms. The company claims that it can undertake design of any type of aircraft for delivery in 1953/54.

The shapers of policy at Canadair are John Jay Hopkins, who heads both parent and daughter companies; J. Geoffrey Notman, Canadian-born executive and general manager; Robert A. Neale, vice-president manufacturing, for many years at Boeing; William K. Ebel, vice-president, engineering; Peter H. Redpath, vice-president, sales, late of T.W.A. and S.A.S.; with John E. L. Duquet, Q.C., J. Gordon Barker (secretary and treasurer) and James F. Tooley (comptroller), all Canadians, looking after the legal and financial aspects.

(To be continued)

R.Ae.C. COMMITTEES

LAST week (page 523) we listed the names of Royal Aero Club officials, and members of the Club Committee, for 1952-53. The constitution of the other committees is as follows :—

Finance.—Capt. K. J. G. Bartlett, G/C. W. N. Cumming, O.B.E., D.F.C., Col. W. C. Devereux, C.B.E., E. S. Greenwood, O.B.E., Maj. R. H. Mayo, O.B.E., G/C. C. S. Morice, D.S.O., M.C., Maj. J. Stewart, O.B.E., C. F. Uwins, O.B.E., A.F.C., Frank Woodhead.

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SURFACE-HARDENED ALUMINIUM

FOLLOWING the appearance of a news-item (*Flight*, February 15th, 1952) dealing with surface-hardening of light alloys as practised by the Glenn L. Martin Co., of Baltimore, Dowty Equipment, Ltd., of Cheltenham, have provided some information on British work in this field.

The Dowty laboratories first studied the subject in 1946 and developed a satisfactory process for the synthetic production of thick anodic films on high-strength light alloys. The film is integral with the metal and is stated to confer the hardness and abrasion resistance normally associated with casehardened or nitrided steel. Film-thickness is controllable, the optimum being 0.003in, of which approximately half is growth on the original surface dimension. Greater depth can be obtained at the expense of surface smoothness.

The hardened surface is stated to be suitable for high-pressure metal-to-metal seals, and use is being made of this property in numerous Dowty hydraulic valves; a high bearing-pressure on the treated surface can be sustained in conditions of poor lubrication. Methods have been developed for machine-grinding the anodic film to close dimensional tolerance with a surface finish of from 2 to 4 micro-inches.

Mechanical properties of the base-alloy are stated to be unaffected by the anodic film; the core-hardness will not, of course, resist indentation by impact, but such indentation—unless due to a blow from a point or knife-edge—will not cause fracture or "bubbling" of the hard film.

A test-application of the process has been made to the pivot journal of an aircraft tailwheel; after 125 miles of simulated rough taxying both journal and the laminated fabric bearing showed no dimensional change beyond 0.0001in, although both surfaces had become highly polished. The process is being applied to numerous Dowty aircraft components, where the substitution of surface-hardened light alloy is expected to save considerable weight.

The side view of a Douglas Skyrocket in flight is eloquent of the machine's extreme aerodynamic cleanness.

FASTEST and HIGHEST

A Record of a Man-Size Job

OF the very few pilots who have flown faster than sound in level flight, probably William B. (Bill) Bridgeman, engineering test-pilot to the Douglas Aircraft Co., Inc., has done so on the greatest number of occasions. We present here a summary of his experiences of supersonic flight, based principally upon a paper which he submitted to the Institute of the Aeronautical Sciences, together with additional details which he gave in an interview with Tom Powers of our American contemporary "Flying."

AT the end of the war, the U.S. Navy and the N.A.C.A. jointly instituted a research programme to investigate flight at higher air-speeds than had previously been attempted, and to obtain in free-flight aerodynamic measurements beyond the capacity of existing wind-tunnels.

The El Segundo division of the Douglas Aircraft Company received a contract to build a prototype for this programme in 1945 and the aircraft first flew on May 28th, 1947. Designated D-558-1, and given the name Skystreak, the design was immediately successful. In August, 1947, the first aircraft twice raised the world air-speed record and showed itself capable of controlled flight up to a Mach number of about 0.85. Three were built.

Shortly after the Skystreak design had been initiated the advantages of swept wings began to be more fully appreciated, and a new design was therefore prepared by the Douglas company, embodying fully swept wings and tail unit. This development was originally intended to be merely a Skystreak fuselage with modified aerodynamic surfaces. But at the design progressed, it became clear that it would be unable to make the best use of these improvements, since the airframe would be unable to reach its limiting Mach number even with the most powerful turbojet installation then available

A supplementary rocket motor—a Reaction Motors model 6000C4—was therefore fitted, which provided, at high altitude, several times the thrust of the Westinghouse J-34 turbojet. Rocket-propellant stowage greatly increased the required fuselage volume and altered the final shape to that of the now well-known D-558-2 Skyrocket.

Though a full description of the aircraft has previously appeared in *Flight* (January 5th, 1950), a number of features are worth reiterating here, in order to provide a better understanding of the behaviour of the aircraft in flight.

Although, as Bridgeman stresses, the D-558-2 is to be regarded as obsolete, the design is interesting in that it is the fastest and highest-flying vehicle ever to carry a human pilot. The obsolescence inherent in the design is chiefly a legacy of the wing-section employed; this is a conventional subsonic profile with a rounded leading edge, and it was adopted to preserve relatively normal low-speed characteristics.

Airframe construction closely follows Skystreak practice, the wing and tail being of 75S aluminium alloy, while very thick magnesium-alloy skinning is used for the fuselage in order to preserve skin-contour accuracy and maintain surface-smoothness. Wing quarter-chord sweep is 35 deg, and built-in anhedral of 5 deg has been employed to offset the excess dihedral-effect of a swept wing at high angles of attack, which can cause "Dutch roll" instability.

All control surfaces are manually operated, without aerodynamic balance; they are of high aspect-ratio and have mass balance at one end (on the tail) or along the leading edge on the ailerons. Although such long-span ailerons can produce severe yawing at low speeds, the Skyrocket is not susceptible to such behaviour, thanks to a combination of effective vertical tail surfaces and free-floating Handley-Page slots. An "all-flying" tailplane is fitted, and the aircraft is provided with simple slotted flaps and Sabre-type aft-fuselage air brakes.

Almost everything is housed within the fuselage—which is consequently 45ft 3in long and over 5ft in diameter. The nose, containing the pressurized and refrigerated cockpit, is jettisonable for pilot escape at high speed. Most of the remaining space is taken by fuel tankage: 250 gallons of petrol for the turbojet and 3,000 lb of alcohol and liquid oxygen for the rocket, together with hydrogen peroxide for driving the rocket fuel-pump motor.

The Douglas company states that care was taken in the original design to locate tankage so as to cause minimum change of trim during burning of the fuel—a matter of no small importance during runs at full speed with a fuel consumption of some 2,000 lb/min. The turbojet exhausts from an elliptical opening under the rear fuselage, the thrust-line passing approximately through the c.g. of the aircraft; the four rocket barrels are situated in the extreme tail.

The special instrumentation installed is entirely automatic and consists basically of a flight recorder, a recording manometer registering air pressure at 400 points on wing and tail surfaces, and a stress-measuring system employing 904 strain gauges connected to a recording oscilloscope.

The first Skyrocket flew on February 4th, 1948; two more were built during that year and all three are still airworthy. During 1948 and 1949 the aircraft were put through an intensive evaluation programme in order to eliminate any possible trouble up to approximately Mach 1. Throughout this period, the aircraft were operated in a conventional manner from Edwards A.F.B., Muroc Dry Lake, California; the phase ended with a spectacular series of low-level fly-pasts, culminating in a press-day held on December 1st, 1949.

Up to this point, the aircraft had not flown appreciably faster than sonic speed, the limited duration and turbojet drag-rise at high speed being detrimental to performance. A further factor was the type of take-off demanded, to which might be applied the adjective "dicey." The wing loading at take-off—about 125 lb/sq ft—combined with the poor low-speed characteristics of the wing to make a very long run necessary. J.A.T.O. bottles were usually employed to help matters a little, but, quoting Bridgeman, "... this I look upon as hazardous. In one instance, all the rubber was thrown from the tyres because I was a little slow in breaking the plane loose from the lake bed. This could be a little rough, in that you are carrying an airplane full of alcohol and liquid oxygen and a nice slug of hydrogen peroxide."

It must have been a relief to the pilots when the decision was taken, after consultation with the Navy, to employ air-launching. Two of the three Skyrockets were fitted for suspension beneath a modified B-29 bomber which was on loan to the Navy. Even more important, the turbojet was removed from one aircraft and replaced by a much-increased load of rocket fuel. Further instrumentation was added at this stage, including equipment for measuring aircraft skin-temperature, particularly over the glass windshields. The "all-rocket" aircraft was then ready to probe still further into the supersonic region and obtain free-flight measurements previously unattainable.

For several months, George Maybrey, the Douglas aero-

dynamicist, allowed Bridgeman (who was the pilot principally concerned with the "all-rocket" aircraft) to fly at gradually increasing Mach numbers until, on June 11th, 1951, the first air launch took place.

The B-29 took off at 10 a.m. with a crew of nine drawn from the Douglas flight-test department. Bridgeman rested in the navigator's office until the 10,000ft level was passed; then he was assisted into the Skyrocket and the canopy sealed over his head. Communication with George Jansen, the B-29 pilot, was maintained by intercom, and Bridgeman also drew upon the B-29 oxygen supply.

The position and direction of the launch was, in this and the five subsequent operations, dictated by wind velocity and the desired flight-plan. Launching was always performed about 25 miles from Muroc, with the B-29 pointing slightly north of the dry lake; the speed run was usually completed about 25 miles beyond the lake on the other side, so that a turn on to the reciprocal heading lined the Skyrocket up on the runway. In all cases, the little aircraft was kept within gliding distance of Muroc to guard against rocket failure.

The operation was controlled by the B-29 pilot; the pilot of the Skyrocket being "blind" until after release, it was the responsibility of the carrier crew to arrive at the correct launching position. The first launch was made at 35,000ft at 240 m.p.h. (this has been reported as an indicated speed, but is almost certainly a T.A.S.).

The first few seconds of free flight appear to have been Bridgeman's greatest worry; a great deal of height could be lost if any delay occurred in firing the rockets. The "throttle" of the all-rocket aircraft consists of a four-step lever, each step firing one barrel; Bridgeman's air-launched flights entailed firing all four barrels as soon as possible.

The usual flight-plan called for a steep (45 deg) climb to be sustained up to the operating height. The level-off is termed, in the U.S.A., the "pushover," and this term figures frequently in the analysis of results obtained. Level speed-runs usually lasted some two minutes to the "all-burnt" condition; speed would then be lost in a wide 180 deg turn to line up for the landing.

Sabres in Attendance

Two F-86 aircraft were employed as observers, one accompanying the B-29 and the other waiting—at a suitable altitude—at the approximate "all-burnt" position, from which point it could guide the Skyrocket in by radio. The second aircraft would have been invaluable if windscreen-icing or structural failure had occurred (in which eventualities it could have (*a*) guided Bridgeman until his screen cleared, or (*b*) marked his parachute touch-down point. Total free flight time was some 13 minutes on each occasion, instruments being used throughout. The cockpit does not appear to have been uncomfortable and there are several reports praising the refrigeration system.

One of the drawbacks of wind-tunnel testing is the restriction on Reynolds number placed on most high-speed tunnels. A great deal of Skyrocket data—which ran to 5,000 reports in 1949—has enabled comparison with tunnel results to be made, particularly over the difficult region between Mach 0.95 and M. 1.1.

The Skyrocket has given results at Reynolds numbers from 5 million to 50 million. Further, variation of lift and drag has been measured at fixed Reynolds numbers, while additional information has given variation of lift coefficient at high Mach number.

The first severe trouble was an unstable lateral condition which was outside the pilot's control. This was noticed on the first air-launch, but its severity was not immediately appreciated. On this first flight the angle of attack was kept so low that the climbing Mach number reached 0.92; the pushover was made gently at 0.7g and only 41,000ft was reached. (At the pushover, 0.7g would be a more gentle levelling-off than one imposing 0.5g; a violent pushover could produce a weightless condition, of course.)

The Mach number, pushover load and altitude were changed with each flight, generally to produce a lower climbing Mach number and pushover load and higher altitude; this resulted in very severe lateral oscillation, which Bridgeman found could not effectively be damped, or even materially reduced.

On the first launch, this oscillation was barely perceptible, with an amplitude of 4 deg each side of horizontal at a speed of 5 deg/sec. As the climb progressed, a rudder oscillation was also discovered—quite a gentle snaking of ± 3 deg at a rate of 3 deg/sec. These movements could be arrested by pedal pressure; and it was also found, on this first flight, that the lateral oscillation could be damped by rudder action—aileron control being less effective.

On the first air-launched flight, Bridgeman says that he "... put the Rocket on the downwind leg at 15,000ft, made a couple of S-turns and went into a glide at 275 m.p.h. I came in over the edge of the field at 250 and touched down at about 190 m.p.h., dead-stick."

The second air-launch produced much more disturbing symptoms. Pushover, at 0.7g, was made at 47,000ft. The aircraft began to roll during the pushover; aileron control was ineffective and rudder feedback to the pedals became so violent that this means also had to be abandoned. Eventually Bridgeman was forced to turn off the rockets, for it became apparent that the oscillations were growing more severe as the aircraft accelerated.

At the top Mach number, wing roll became ± 10 deg at 15 deg per second, together with a yaw of ± 1 deg; the rudder travel remained at ± 3 deg, although on this occasion it was forced, i.e. could not be arrested. Bridgeman discovered the yaw only during the analysis of the flight records.

After much discussion it was decided to fit a hydraulic plunger to the rudder so that the control would remain locked during flight at high speeds, but could be brought into use during landing. This was done—not in the hope of finding a "cure-all," but merely to enable testing to proceed.

On the third air-launch—with the rudder locked—the lateral oscillation persisted, but aileron control returned sufficiently to permit controlled flight. The maximum Mach number reached was very considerably increased on this occasion, and Bridgeman felt most of the troubles had been overcome. Previously, the lateral oscillation frequency had been so high that any attempt to damp it usually resulted in the pilot getting in phase with it and making matters worse; now it was possible, with the more sluggish roll, to arrest it by using opposite aileron.

During post-flight analysis it was found that locking the rudder made it possible to obtain control with one-quarter of the aileron force previously used, while the yaw had been reduced to less than 0.5 deg; roll became ± 3 deg at 7 deg/sec. Incidentally, the rudder was found to be floating about 0.1 deg in spite of the lock.

Hopes of finding a controllable supersonic aircraft were dashed on the fifth launch. In an effort to obtain higher speeds on the level, the pushover was made much more rapidly, the loading dropping from 0.6 or 0.8g down to 0.25g. Bridgeman describes the result as being the most interesting he encountered. As the loading fell off at the top of the climb, a violent roll developed, which eventually reached an amplitude of ± 75 deg at a rate of 86 deg/sec. In addition a sideslip of $\pm 6\frac{1}{2}$ deg was experienced.

Up to 65 lb stick-load was used on the ailerons, but their effectiveness was so low that Bridgeman gave up; he was, in addition, finding it very hard to keep out of phase with the roll. He points out that this occurred at close to the peak Mach number ever attained. The ride eventually became so rough that power was cut. But the oscillations did not abate; they became even more violent. This prevented a steady bank from being made, and Bridgeman must have expected to be carried outside gliding distance of Muroc. Eventually the rolling was damped by applying a longitudinal load—which reached 4g—and the 180 deg turn was made.

Data analysis showed that the yaw had produced a rudder-hinge

One of the three Skyrockets is taken aloft by its parent Superfortress, loaned by the U.S.A.F. Such a method of air-launching was found to be essential for the attainment of flight at Mach numbers in excess of unity. The B-29 fuselage was drastically rebuilt to enable the Skyrocket to be neatly housed; in particular, a large slot—for the Skyrocket tailplane—cut in the aft fuselage completely removed the lower half of the fuselage periphery.

FASTEST and HIGHEST . . .

moment of 750 lb in, equivalent to an 80 lb pedal-force. The lessons of this fifth flight were taken to heart and the sixth launch resulted in the most successful flight of all; it also produced the highest Mach number.

In order to escape the high drag met at an immediately transonic speed, the angle of attack in the climb was increased as rapidly as the stall-warning buffet allowed. Once, when the warning boundary was entered too deeply, the starboard wing dipped in a partial stall. Buffet limitations prohibited a climb being made at the ideal Mach number of 0.8.

A little oscillation occurred at the top of the climb; the pushover was entered gently at 0.8g, which was then reduced to 0.6g without ill effect. A pronounced left-wing heaviness then made a return to 0.8g necessary, but lateral control returned and the aircraft was then left at 0.6g until the "all-burnt" condition was reached. The actual figures obtained on this flight have not yet been released.

Bridgeman says he was never able to make a climb that satisfied the aerodynamicist. The Mach number always crept ahead of him by 0.05, so that he reached sonic speed some 8,000ft too low. Every effort was always made to keep the climb sufficiently steep to hold the Mach number at about 0.85 as long as possible. At the beginning of the climb, with a wing loading of some 100 lb/sq ft, difficulty was experienced in pulling up to a steep attitude sufficiently quickly without inducing a high-speed stall. The lag of 10 seconds before obtaining full thrust from all four rocket-barrels aggravated this, and the limiting load was found to be about 1.6g.

The best stall-warning was found to be the vibration of the long needle-nose boom, which was all that could be seen of the airframe by the pilot; Bridgeman says he had calibrated it as a stall-indicator.

The climb was further complicated by, in the first place, the phenomenon of a rapidly rising Mach number and a falling I.A.S., and secondly, by the rapid fuel consumption. This latter caused great variation in wing loading and allowable angle of attack, while the I.A.S. eventually became so low that the aircraft had to be permitted to exceed Mach 1 while still in the climb. At this point, the elevators, being conventional surfaces, ceased to be effective; further longitudinal control was maintained by the "all-flying" tail, this being used to control the pushover. The speed-run after the pushover did not pose any great longitudinal problem.

The necessity of making a turn through 180 deg immediately the "all-burnt" condition was reached meant that the turn would be entered at the highest Mach number reached. Bridgeman always found these turns difficult and educational. He found that entering a vertical bank and applying full up-elevator did not alter the course of the aircraft by as much as a degree; on the other hand, application of 3 or 4 deg (or, on occasions, all that was available) of "all-flying" tail movement could bring the load factor to about 4. This control *via* the tailplane made it possible to enter a diving turn and return to base.

This turn was made more difficult if rapid lateral oscillation was present, as previously described. An undesirable feature was the need for returning the tailplane to neutral soon after the turn had been started; this was due to the sluggishness of the electric actuator at the extreme air-loads encountered by the tailplane. This made it essential to relieve the load factor almost as soon as it began to take effect in order to prevent a stall.

Bridgeman has mentioned an occasion when the angle of attack reached 18 deg in the early part of one of these turns; although the Mach number was greatly above unity, the I.A.S. was low. Before the trim could be centralized, violent pitching occurred and nearly produced a complete stall. The effect was aggravated on this occasion by the fact that the speed dropped to a subsonic value as the turn progressed; this caused a shift of centre of pressure by about 10 or 15 per cent forwards, imposing additional loading by trying to tighten the turn.

Only a few air launches with the all-rocket aircraft have so far been announced. Bridgeman stresses the fact that a research programme must be a co-ordinated whole allowed to grow only in easy stages. He feels there is much untapped potential left in the Skyrocket and hopes to reach still greater speeds and altitudes.

He makes a plea for a "genuine" supersonic aircraft capable of keeping above Mach 1 for a time measured in minutes, not seconds. It must, he says, have a true supersonic wing section and be equipped with adequate irreversible controls—and, perhaps, a yaw damper. An efficient air-conditioning system is a further requirement, while he hopes that much attention will be paid to the problem of aerodynamic heating at high speeds.

Evidence that this plea will not go unheeded is provided by the forthcoming Douglas X-3. This perhaps most advanced of all aircraft is the outcome of many design-studies with turbojet, rocket and ramjet propulsion, used singly or in combination. It may fly this year, and will present Bridgeman with an even more "man-size" job than has been described in this article.

W.T.G.

WORK OF THE N.P.L.

REFERENCE to the work of the Aerodynamics Division of the National Physical Laboratory is made in the annual report of the Department of Scientific and Industrial Research.

It is stated that the new 18in x 14in subsonic and supersonic tunnel has been installed and has been found to operate satisfactorily at atmospheric pressure. It will later be run at pressures up to three atmospheres and will provide facilities for high-speed research under conditions more nearly corresponding to full scale than those possible with the earlier equipment.

In pointing out that the damping of the pitching motion of high-speed aircraft is of vital importance in aerodynamic design, the report says that experimental and theoretical research on oscillating wings in high-speed flow have been continued intensively, and "important progress" made as a result of this work.

Additional facilities have been installed for the study of the interaction of shock waves and the viscous layers near solid surfaces in high-speed flow. Experiments on the maintenance of non-turbulent flow over wing surfaces have also been continued as part of a concerted plan—including flight research elsewhere—to achieve some of the large economic gain theoretically possible.

In a section dealing with the properties of materials at high temperatures, the report refers to the continued studies of the stress-short-time plastic strain relations and stress-creep relations under conditions of combined stress, attention being particularly directed to investigation of the effects of anisotropy produced by pre-straining in tension or torsion.

An associated investigation concerned with the fracture under combined stress-creep conditions of a 0.5 per cent molybdenum steel at 550 deg C has shown that fracture conforms with a criterion of maximum principal stress.

It is stated that work on the temperature dependence of creep for an aluminium alloy has reached the report stage, and the time dependence of creep is being currently studied. Further tests to obtain information on the behaviour of eccentrically loaded light-alloy struts have been made.

Noting that theoretical and experimental studies of creep due to fluctuating stresses are proceeding, the report mentions that examination of the speed effect in fatigue between one cycle and 8,000 cycles per minute for a light alloy and a mild steel at various temperatures has shown the effect to be important. Interesting correlations of results in bending and direct stress fatigue have been obtained.

It is stated the considerable creep and fatigue work has been undertaken in connection with material for use in gas turbines.

Dealing with stress analysis investigations undertaken by the Engineering Division, the report mentions that an analysis of the elasticity of fibre matrices, originally made in 1942-1943, has been revised for publication. It relates to fibre-filled synthetic resin bonded materials, and is concerned in particular with the effect of varying the form and orientation of the fibre filling on the elastic properties of the materials. The work is stated to have a bearing on the design of plastic aircraft structures and its publication was requested by those engaged in this development.

There is also a reference to the initiation and propagation of fatigue cracks in metals. Experiments were made with test pieces of mild steel subjected to combinations of alternating bending and torsional stresses in such a manner that the regions of high stress due to bending and those due to torsion were partially separated. The results indicated that fatigue cracks may develop either along planes of maximum shear or across planes of maximum tension, and that each type of crack tends to propagate in its own mode. This technique of testing will now be applied to other materials. It is mentioned that a second fatigue-testing machine of 1,500 lb capacity, operating on the slipping-clutch principle, has been constructed.

A summary of work done by the Metallurgy Division shows that researches of a theoretical type have been undertaken on the constitution of uranium alloys for the Directorate of Atomic Energy, and on the constitution of magnesium alloys for the Ministry of Supply. Work on the high temperature properties of magnesium alloys used in aircraft engines has also been undertaken.

The Physics Division reports that considerable attention has been given to the measurement of noise from aircraft, both on the ground and in the aircraft itself, and that a portable sound-level meter and octave-band analyser for measurements in aircraft have been designed and constructed.

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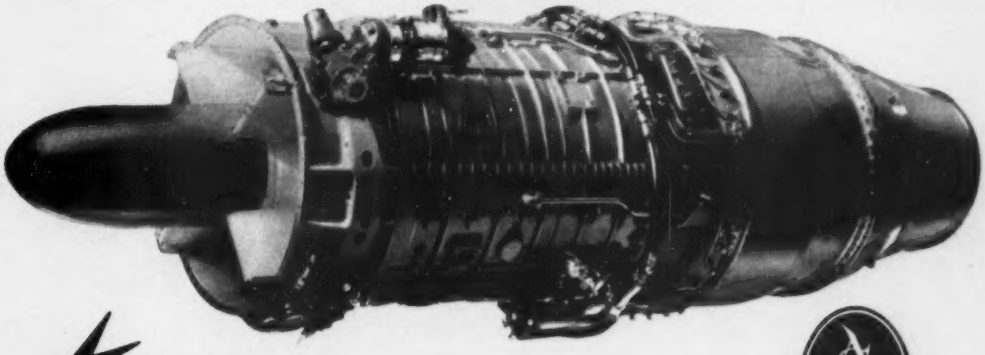

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THE QUEST FOR POWER

Bristol Engine Division Facilities for Gas Turbine Research and Development

By C. B. BAILEY-WATSON

There's naught so easy, but when it was new
Seemed difficult of credence, and there's naught
So great, so wonderful, when first 'tis seen,
But men will later cease to marvel at it.

THUS Lucretius, and of course he is right; novelty is the most transient of qualities. Yet all research, indeed all progress, is based upon the compulsion within mankind to strive toward newer things. And it is, perhaps, only human to expect that something newer will be something better than that to which one is used. So man goes forward.

The trouble is that we who are (comparatively) young in this year of 1952 are conditioned by education and the vicarious experience of films, radio and the written word to take marvels in our stride. Thus to some extent our sense of values has become diminished. It is a matter of degree in the scale of general material understanding.

At the present time in London, at Burlington House, one can see some of the works of Leonardo da Vinci, the exhibition marking the quincentenary of his birth. This giant mind towered overwhelmingly above the material intellectual level of its contemporaries. But would it today? There is little doubt that, in any age, Leonardo would have stood out as a man possessing remarkable gifts. But what of Galileo, Newton, Pasteur, Rutherford, Faraday, Watt, the Curies, Kelvin, Einstein and others? These, too, are names which will live, but with the possible exceptions of Newton and Einstein (each of whom has contributed fundamental instruments of reasoning), it is doubtful if they will be accorded parity with Leonardo in the final assessment. A man must be measured against the standards of his time.

Necessarily, as technology has advanced, it has become progressively more difficult for a first-class mind to exhibit great advantage over its contemporaries; some advantage it will always show, but again, it is a matter of degree. In a nutshell, it is simply that the field of material investigation—as distinct from that of abstract reasoning—has now become widely explored and to this extent possibly offers the fewer opportunities for great discovery.

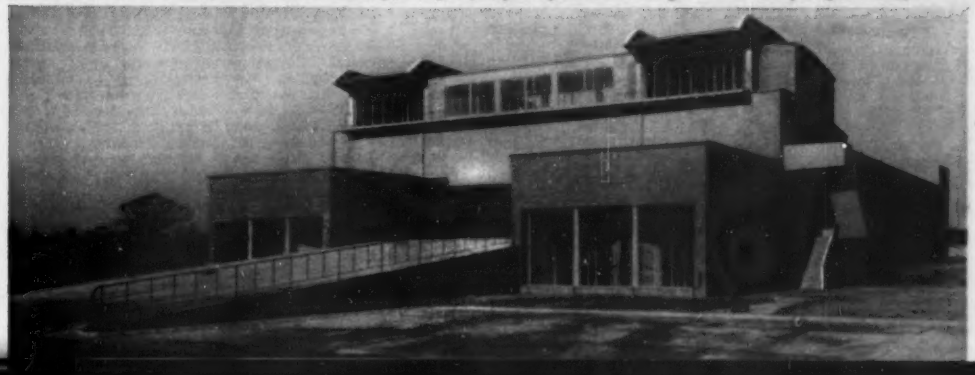
There is, however, enormous scope for advance in detail discovery, and in application: a matter largely of method. All over the world men of high intelligence in a myriad specialized fields are working not so much to discover new things as to develop to a higher degree—and probably in changed form—that which already exists. It is certainly so in the field of power production by prime movers, and within this field there is not much room for doubt that the greatest intensity in development is devoted to aircraft gas turbines.

The gas turbine is, of course, a newcomer among the prime movers, and as such has a great development life ahead of it. How it will compare with the development of the classical piston-engine is not easy to see. To date, the aircraft piston-engine has achieved a $\times 29$ increase in power/weight ratio, and a $\times 21$ increase in power/swept-volume ratio. Unfortunately, there is no direct basis of comparison between the gas turbine and the piston-engine, but it is of some point to note that, whereas the original Whittle W.1 engine was cleared for flight at a static thrust of 850 lb, this corresponding to a mass flow of about 21 lb/sec, and a specific installed weight of 0.73 lb/lb thrust, turbojets today are achieving static thrusts in excess of 8,000 lb, mass flows of over 150 lb/sec, and specific weights of the order of 0.34 lb/lb thrust.

It would be precocious to suggest at this comparatively early stage that the gas turbine will not achieve over the years a power/size increase comparable with that of the piston-engine; it is, however, justifiable to say that it would seem to be unlikely, if only because the scope for technical refinement is less. On the face of it, this itself appears to be a somewhat sweeping statement, but it must be remembered that, whereas the piston-engine started at a time when technical knowledge was comparatively undeveloped, the gas turbine came at a relatively advanced stage of technological understanding. This is not to imply for a moment that we now know it all, that there is nothing left to learn; on the contrary, it is simply that the extent of the unknown is just that much less.

How much there is still to be learned, and the difficulties in the way of gleaning that knowledge, is apparent to anyone examining the elaborate research and development equipment necessary for the quest. The facilities employed by the Engine Division of the Bristol Aeroplane Co., Ltd., serve well to indicate what is involved. There are numerous test buildings, each devoted to some specific line of inquiry, but overshadowing all, both in size and equipment, is the Turbine Research Station—a well laid-out building of no

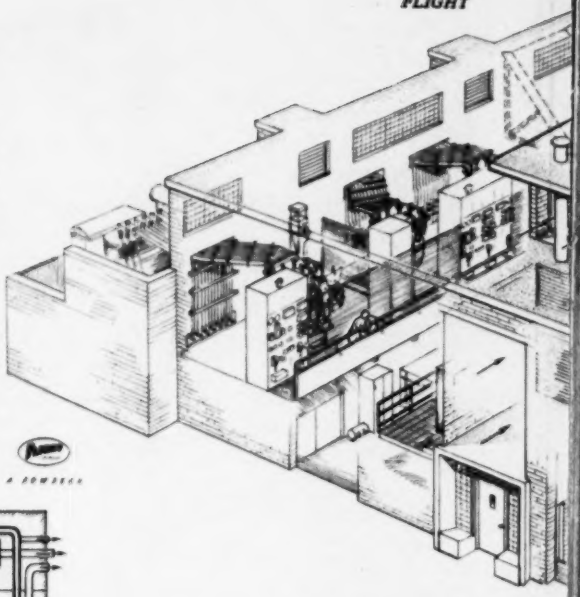
(Top) South front of the Turbine Research Station, more familiarly known to hundreds of Bristol Engine Division personnel as "the gin palace." (Below) South front of the twin test-bed building for large-capacity turbojets. Both buildings are model examples of their kind.

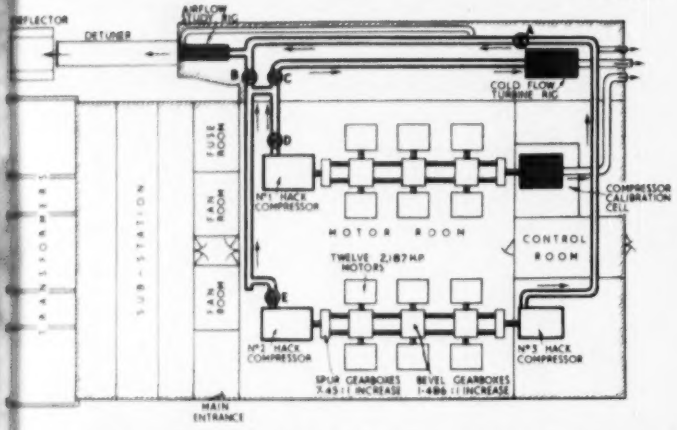


little architectural merit, and quite undeserving of the affectionate nickname "the gin palace" bestowed on it by the engine research personnel.

The station was first proposed early in 1944, and the building was completed and put into commission in March, 1947. As originally envisaged, the layout of the station was such as to enable gas-turbine compressors to be calibrated separately, or run in conjunction with the appropriate turbine. To this end, an electrical drive comprising identical motors and generators was selected, and was so designed as to be largely self-sustaining on a regenerative basis. That is to say, the compressor was to be driven by electric motors, the mass flow from the compressor being ducted through combustion chambers to a turbine, which would drive generators, the electrical output of which would supply the compressor-driving motors. Operation of the station was begun with two compressor-driving motors and two turbine-driven generators, but in 1949 second pairs were added to each string, these being supplemented in 1951 by the final addition of third pairs.

In the autumn of 1949, however, it was decided that a basic rearrangement of operational function was necessary. The link-up between compressor and turbine meant that the utility of the station was limited and, in any event, the value of turbine assessment was questionable because of the extreme difficulty of obtaining accurate measurements of small temperature changes at the high gas temperatures involved. In place of the turbine, therefore, a hack Proteus compressor was installed, and turbine testing vested in a cold-flow rig in an annexe on the north side of the building. Still further to increase the mass-flow capacity, two more Proteus hack compressors were installed, one each at the western ends of the motor drives.





THESE exclusive drawings by "Flight" artist Arthur Bowbeer show with remarkable clarity the topography of the Turbine Research Station, and the equipment installation. Reference to the plan on the left, will amplify understanding of the duct layout and the possible variety of flow paths, (valves are letter-annotated). In addition, it should be noted that air supply to the compressor calibration cell is conveyed through the large, bricked roof-duct, immediately below which is the intake for the centrifugal fans which supply cooling air to the motor driving strings. This cooling air is conveyed to the motors through under-floor tunnels which also accommodate the main bus-bars. Exhaust air from the compressor cell is piped up to the roof duct and so escapes to atmosphere, whilst exhaust air from the cold-flow turbine rig and the airframe study rig is vented to atmosphere through lengthy de-tuners.

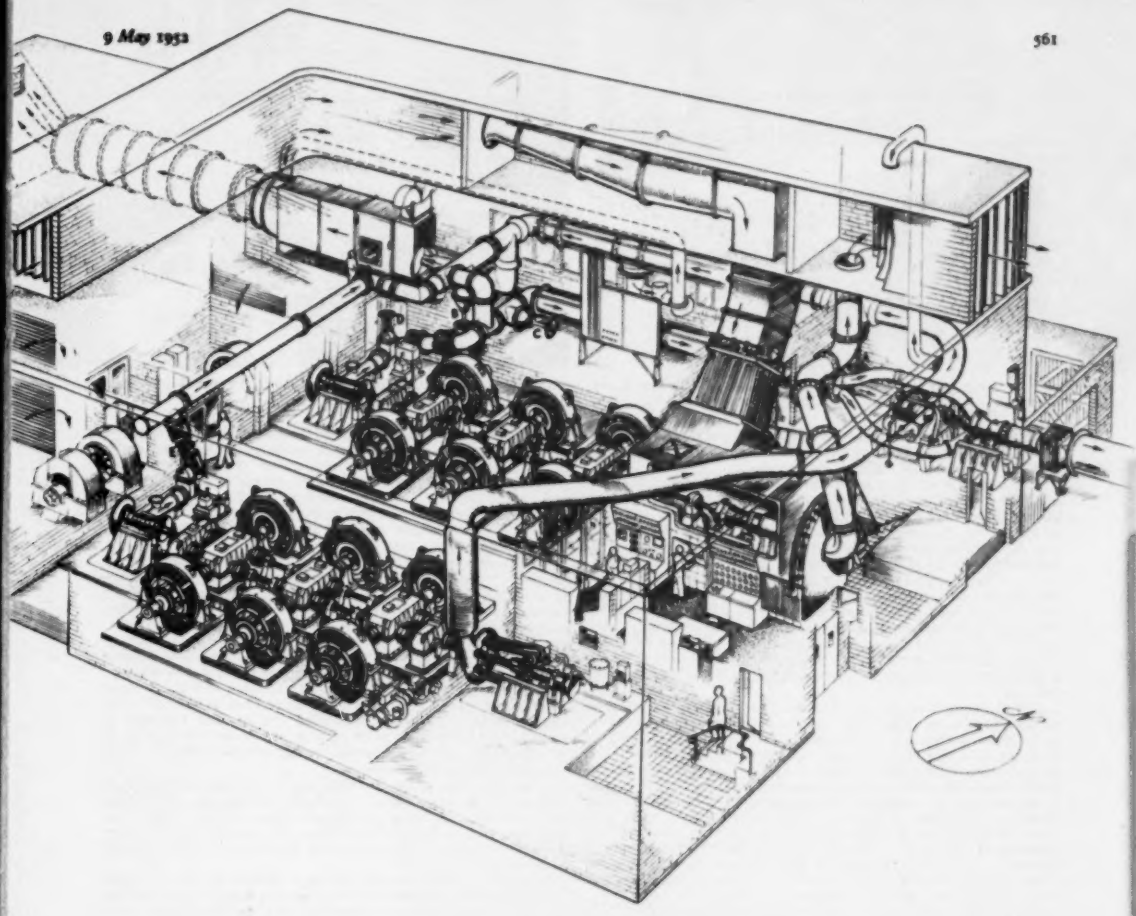
To revert to the electrical drive system, the plant was manufactured and installed by the English Electric Co., Ltd., each motor having a normal rating of 1,750 h.p. at 900 r.p.m., and a maximum rating of 2,187 h.p. at 972 r.p.m. Arranged in pairs, the motors give their drive through bevel boxes joined by Layrub-coupled shafts, and at each end of each "string" of motors are final speed-increasing spur-gear boxes, so designed that the drive ratio to suit particular compressors can readily be changed. The bevel and spur boxes were manufactured by David Brown and Sons, Huddersfield, and the first stage of speed increase is vested in the bevel boxes, gears of 37/55 teeth giving a motor/output-shaft speed ratio of 900/1,338 r.p.m. These gears are of 2 D.P. and 4in face width, and are made in 2½ per cent nickel-chrome-molybdenum steel. The spur gears are of 9in face width, also of 2½ per cent N.C.M. steel case-hardened and ground, and in the case of the highest speed ratio available, gears of 149 teeth (5 D.P.) mesh with a 20-tooth pinion, i.e., they give a speed ratio of 7.45 : 1.

A new final drive system for compressor testing is in hand to replace the existing units. Manufactured by David Brown, it will consist of a new gear box comprising single helical, spiral bevel and double helical increasing gears with a single output shaft to new double helical geared torque-reaction co-axial units. The new final drive will provide alternative output speeds of 7,000 r.p.m. and 10,000 r.p.m. and, neglecting friction losses, is designed to transmit, at these speeds, powers of 10,500 h.p. and 7,000 h.p. respectively.

The incoming electrical supply at 11,000 volts is fed to two 3,620 kVA and one 5,100 kVA 50-cycle tap-changing transformers which deliver current to four 2,100 kW six-phase mercury-arc rectifiers, with a D.C. output variable up to 750 V. The total D.C. output under normal conditions is, therefore, 8,400 kW, but a 25 per cent overload is available for limited periods. Continuously variable speed control over the whole speed range is obtained by a combination of rectifier grid control, transformer tap-changing, and motor field control.

As the original scheme was based on regeneration, however, the total transformer, rectifier and cable capacity was restricted to 15,400 h.p. This meant that each motor string of six x 2,187= 13,122 h.p. could be run separately, but if both strings were run simultaneously, their combined potential of 26,244 h.p. could not be used; they would be limited to the 15,400 h.p. imposed by the electrical switchgear system. Furthermore, to ease control problems under combined running conditions a single control regulated the speed of both sides in unison, and a speed differential of only ± 15 per cent could be achieved by means of a supplementary control; thus simultaneous but independent running was not possible.

Understandably, these limitations have cramped the scope of use of the test plant, the more seriously because of the increasing urgency of gas-turbine research. Work is now well in hand, how-



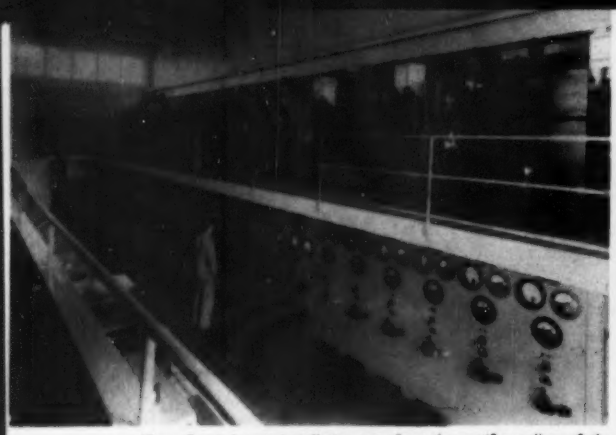
ever, to augment the electrical installation with two new transformers, each of 5,100 kVA, and two rectifiers, each of 4,200 kW, so that additional d.c. output of 8,400 kW will be available. These modifications, when completed, will enable both driving strings to be run at the full capacity of 26,244 h.p. in collaboration or independently.

In view of the not inconsiderable limitations which have so far existed, it is the more praiseworthy that the use of the station should have increased to so large an extent over the years. In the first year of commission (1947) only 49 hours' running was done—on compressor testing—and in the following two years, the annual figures were 212 and 329 hours inclusive both of compressor and hot-flow turbine running. In 1950 and 1951, however, the hours have exceeded 1,000, despite the delays occasioned by installation of the additional driving motors. The large increase in utility of the station was, of course, largely a result of the change-over to cold-flow turbine testing: an innovation of tremendous consequence. So long as research on turbines was confined to hot-flow conditions, it was hamstrung by (i) the great difficulty in making sufficiently accurate measurements of the entry and exit temperatures and pressures; (ii) the complexity of the rig resulting from the requisite combustion units, and in addition the actual mechanical quality of the rig necessary to meet the demands of what is, in effect, a full gas turbine; (iii) the severe limitations of rig flexibility resulting from the difficulty of meeting designed operating conditions, let alone exploring conditions other than these; (iv) the considerable expense, in terms both of money and time, of blade and disc manufacture in normal materials for the large number of components required for research testing.

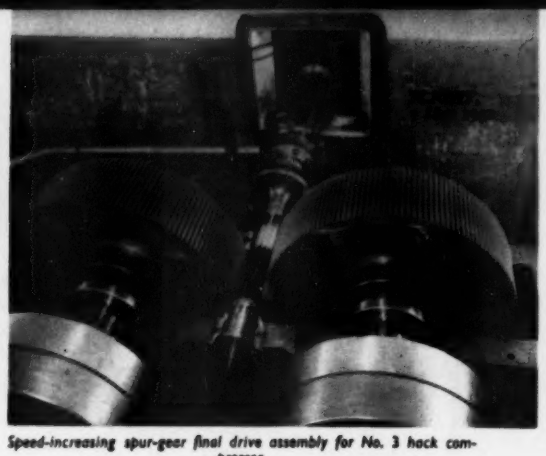
The objects of cold-flow turbine testing can be summed up as follows: (a) Basic research into blade-form variables, exploring the possibilities of radical designs which would be too uncertain to risk in an actual engine. (b) Detail development of existing components: the ability accurately to measure small changes in efficiency permits investigation of the effect of a large number of possible small design modifications in order to select those showing a positive gain, and aggregate them into one assembly showing a worthwhile gain in the engine. (c) The investigation of aero-mechanical vibration effects under controlled conditions without the difficulties associated with high temperatures.

The performance information required for a turbine is its efficiency, flow capacity and outlet swirl at any given speed and pressure ratio. By the use of non-dimensional parameters these qualities can be synthesized graphically in terms of efficiency, non-dimensional flow and outlet swirl against total-head pressure ratio for a number of non-dimensional speeds $\left(\frac{N}{\sqrt{T}}\right)$ although for large changes in Reynolds number allowances must necessarily be made. In practice, the cold-flow rig employs a Theseus reduction gear for coupling the turbine under test to a Heenan and Froude DPX 8 hydraulic dynamometer, and the required turbine operating conditions are obtained by throttling the inlet and outlet flows to give the desired pressure ratio across the turbine, whilst the water-brake is loaded to give the turbine rotational speed equivalent to the requisite $N/\sqrt{T}$.

Mass flow is measured with a B.S.S. orifice in the inlet ducting; turbine entry temperature is measured with a comb of thermocouples immediately upstream of the turbine stator, whilst turbine entry pressure is measured with a pitot comb. Horsepower is, of course, determined by the dynamometer; gear efficiency is calculated from a separate heat-to-oil calibration; outlet swirl is measured with a traversing three-hole yawmeter; whilst outlet static pressure is taken at four inner and four outer tappings in a



View of switch-gear installation seen from the rectifier gallery of the electrical sub-station.



Speed-increasing spur-gear final drive assembly for No. 3 hack compressor.

machined annulus. The quantities derived by these means enable the outlet total head pressure and outlet temperature to be calculated, and the isentropic efficiency determined.

Cold-flow test turbines are made up with mild steel discs and cast light alloy blades (Bristols have, indeed, evolved a technique for gravity die-casting blades in Birmidal—a casting light alloy produced by the Birmingham Aluminium Casting Co., Ltd.), and thus the interval between designing a new blade form and testing it on the cold-flow rig is short—a matter of two or three weeks rather than the nine months or more which might be necessary for the manufacture of "hot" blades. Since the cold-flow rig was installed in May, 1950, and up to the end of 1951, no fewer than 75 assemblies have been calibrated during a running time of nearly 1,200 hours. The value of the rig has shown itself in a number of ways, and to select but one of these, detail development has led to an improvement in turbine isentropic efficiency of no less than six per cent.

Just as research on turbines has led to marked improvements, so, too, has the complementary work on compressors resulted in an increase in efficiency. The compressor under investigation is mounted in a cell (north of the control room) and running is normally carried out over a range of speeds. At each speed the flow is varied by adjustment of throttles in the inlet and/or outlet ducts, whereby the complete characteristics may be determined. Obviously, the choice of inlet and/or outlet throttling is dependent upon the particular test requirements; it may, for example, be necessary to throttle the intake air to reduce the compressor power demand to that available from the motors (total 13,122 h.p.), or it may perhaps be desirable to test the compressor under entry-pressure conditions relevant to operation at altitude.

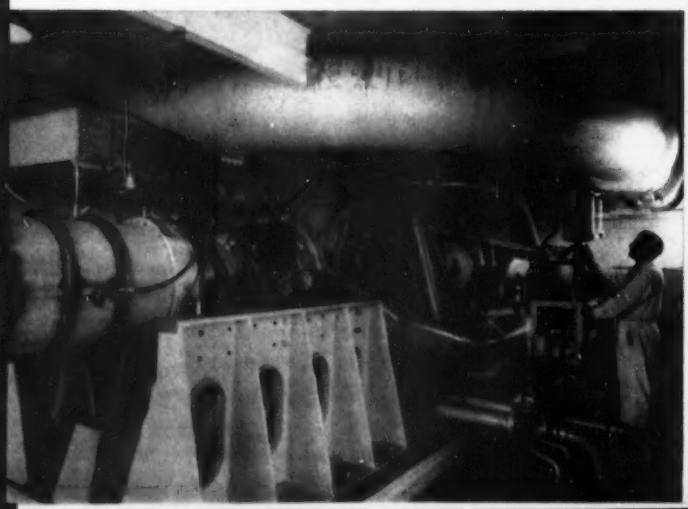
The primary data sought in a compressor calibration are those which will permit a characteristic to be plotted. These data are synthesized in non-dimensional parameters, and the conventional compressor characteristic is a plot of pressure ratio against equivalent flow $\left(\frac{W\sqrt{T}}{P}\,\frac{14{\cdot}7}{\sqrt{288}}\right)$ for various equivalent speeds $\left(\frac{N}{\sqrt{T}}\sqrt{288}\right)$. Efficiency contours, or curves of equivalent temperature rise ($\Delta T/T$) are also drawn. The requisite measurements are taken as follows: air mass flow is measured by a venturi in the inlet ducting; pressure ratio is measured by pitot combs in the inlet and outlet ducts immediately up- and down-stream of the compressor; temperature rise is measured by thermocouple combs at the inlet and outlet; and r.p.m. are registered by a B.T.H. Maxwell indicator. Wherever possible, manometers are used in preference to pressure gauges, whilst specially developed thermocouples are used for temperature measurement.

The procedure outlined is sufficient to give all the information necessary to enable the performance of an individual compressor to be assessed, but, in fact, it is usual to amplify the picture with detailed data of inter-stage characteristics. For these purposes, a great many static pressure tappings are provided on rig compressors at each stator/rotor stage so as to enable an estimate of individual stage performance to be made. In addition, detailed probings are also carried out with a traversing "yawmeter" inserted in place of a blade row, and by this means a comprehensive picture of inter-stage flow distributions can be derived. The traverse gear is remotely controlled and enables readings of pressure and swirl-angle to be taken at any point in a segment of the compressor annulus; traverse readings are also taken for entry and outlet flow distributions.

Some indication of the dividend paid by the development work undertaken on compressors is given by the fact that, by altering blade settings in terms of stagger angles, throat widths and numbers of blades in any given stage, improvements of no less than 20 per cent in compressor mass-flow capacity have been achieved without basic re-design.

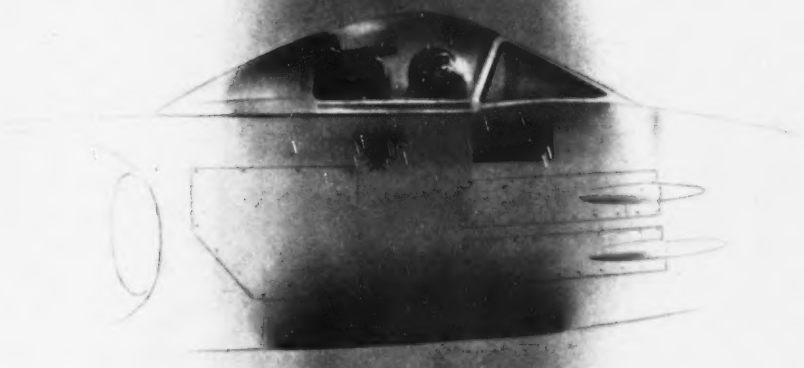
Before leaving the Turbine Research Station to consider other items among the research facilities, mention should be made of the high-speed flow rig at the western end of the annexe on the north side of the building. This extremely useful research tool is not a wind tunnel, but rather an airflow study rig permitting tests of engine ducting and of model units to be carried out at speeds up to Mach 1.8. There are, in addition, a variety of rigs available for general air-flow and cascade tests, including a 50in water-gauge Sirocco fan of 15,000 cu ft/min capacity; a 100in water-gauge Sirocco fan of 7,200 cu ft/min capacity; and four 30-lb/sq in Nash

Turbine cold-flow rig with test turbine and Theseus reduction gear in foreground, and hydraulic dynamometer in background.



One of the diffusers in the large-capacity turbojet test-house, showing jet tail-pipe extension of the engine under test delivering into the trumpet mouth of the diffuser trunk.

Ejection Seats



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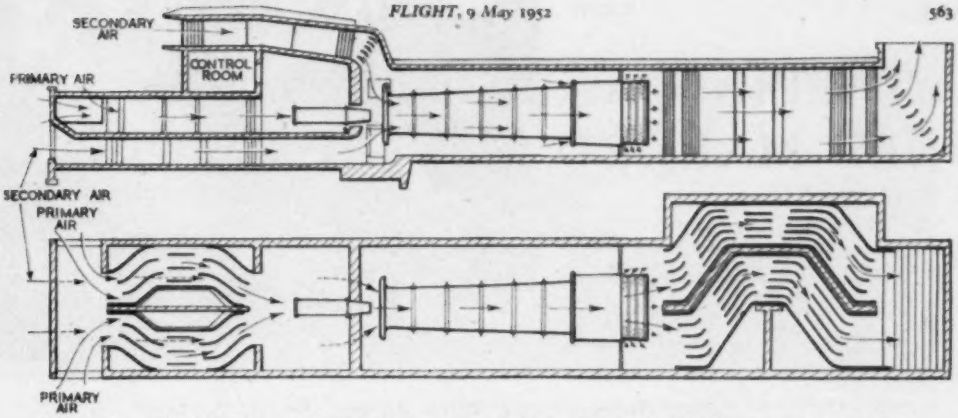


Section and plan of one half of the test-bed building for large capacity turbojets. The cascades and diffusers ensure a low noise-level.

THE QUEST FOR POWER . . .

Hytor compressors each of 450 cu ft/min capacity. Another flow rig which has proved invaluable is an adaptation of a normal (piston engine) supercharger test rig. A Centaurus hack supercharger is driven by a 600 h.p. electric motor to supply air to a scale model turbine with precision cast blades—another variant of the cold-flow rig. The turbine is coupled to a Hercules supercharger acting as a dynamometer in that load on the turbine is varied by controlling the quantity and back-pressure of air passing through the Hercules blower. The primary purpose of the rig is to study the characteristics of various forms of turbine exhaust duct, and for this purpose the model ducts are made of wood, the delivery temperature of the air being reduced by means of water-circulation heat exchangers.

There are, in addition, two rigs which offer some considerable attraction to the primeval appeal of destruction which seems to lie not far beneath the surface of most of us. They are for over-speed testing. Of the two rigs, one is designed especially for the research testing of components to destruction. The test cell can be exhausted so that the power required to spin the component is reduced, and in order to mitigate the effects of component failure, the walls of the cell are lined with wooden beams and hung with "propeller netting." Drive is by a 300 h.p. motor through a pair of gearboxes, the first of which offers alternative gear ratios giving final drive speed-increase ratios of 12.5:1 and 16.3:1; the maximum speed is limited by the rating of the second gearbox to 17,000 r.p.m.

As is only to be expected, an overspeed test to destruction is conducted only after full data have been obtained on the elastic and permanent deformation of the component over the speed range. An interesting tool which has been developed especially to measure the radial growth of a component under centrifugal load is an optical dilatometer. A light beam is projected across the rim of the component (e.g. a turbine wheel), the resulting shadow being magnified through a prism and lens system and projected against a scale which can safely be read through a window in the steel door of the cell. Any diametral growth of the component being spun can thus be accurately discerned without risk.

Of the test beds for full-scale engine running, by far the largest and most modern are an identical pair housed in a single building, the design merit of which, like that of the Turbine Research Station, is of a high order. These beds are each capable of accommodating turbojets of up to 15,000lb static thrust, and in that the mass flows associated with powers of this order are enormous, the chief considerations monitoring the design were recognised as being acoustic in character. To this extent, the building must be regarded as particularly efficient, for an unusually high degree of silencing is obtained. Appreciation must be accorded Cementation (Muffelite) Ltd., on these grounds, for in addition to making and supplying the silencing equipment, they also advised on the essential design of the building.

The building comprises "mirror image" halves about an imaginary north/south longitudinal centre-line, the south front of the building being approached by a long concrete ramp, the landing of which gives directly (through massive steel doors) into the engine rooms. South-extending wings flank the head of the ramp, and each incorporates grilled openings for air entry : the control room spans the full width of the building at "first-floor level," that is to say, above and behind the engine rooms, and although a single apartment, is furnished in duplicate halves each of which serves one bed. At the ends of the control room, and above it, is an additional pair of grilled air-entries.

As may be seen from the sectional drawing of one half of the building, the engine under test derives its air from the upper side aperture in the south wing, the lower front aperture serving the diffuser chamber as does the top entry above the end of the control room. The diffuser chamber walls are lined with corrugated light alloy over a 2-in thick lagging of glass-wool, the primary purpose of which is to provide thermal protection for the concrete structural skin of the chamber. The diffuser itself consists of a divergent circular-section trunk fabricated in ¼-in mild steel plate, and is mounted on rails whereby axial movement is facilitated. At its downstream end, the diffuser terminates in a spreader drum with perforated walls and angle-iron baffle-bars. On emergence from the spreader drum, the diluted gases pass through walls of vertical splitters arranged as "dog-leg" passages giving on to the base of a vent stack where horizontal turning vanes direct the stream upward and so out to atmosphere.

Insofar as the test cradle and control arrangements are concerned, one of the chief points of interest is that the cradles are arranged so that the observer in the control room looks down on and axially along the engine from the front : a not inconsiderable safety measure. The cradles are of cast steel, the engine carriages being supported in the mounting structure by four steel laminations which permit movement of the cradle for thrust measurement, yet incur negligible friction. Thrust is measured by an Avery weighing machine operated through a straightforward mechanical linkage from the cradle. The control panels and desks form a neat installation and, unusually, arrangements are made for automatic film recording of dial readings. Another refinement is that all engine services run down in a duct from the control room to terminate in a manifold panel alongside the cradle.

At the beginning of this article it was observed that novelty is the most transient of qualities. It is, however, worth remembering that it is on the technical novelties of today that the text-books of tomorrow are based.

SPEEDING-UP

AMONG the most pressing problems facing the aircraft industry, commercial operators and airfield owners today is the saving of time and manpower in handling their materials, products and freight. It is for this reason that executives of such concerns will welcome the holding of the Third Mechanical Handling Exhibition and Convention at Olympia, London, from June 4th to 14th.

There will be plenty to interest them. Many of the exhibitors have for some time past supplied mechanical handling appliances —not in ones and twos, but in batches—to aircraft manufacturers and to airports. The latest types of mobile crane, particularly suited to work on airfields, will be shown. One is equipped with a hydraulic ram for raising and lowering the jib. Finger-tip control is provided, giving easy and safe control of derricking operations.

Tractors for hauling aircraft will be exhibited—one for handling 60 tons' gross weight. There will be also specially designed trailers for use at airports, and included among these is a trailer that can be lifted by fork-lift trucks. These fork-lift trucks, coming into increasing use in aviation, will be well represented among products of a number of exhibitors.

In addition, there will be on view many handling appliances suitable for aircraft construction and maintenance, such as an hydraulic elevating working platform rising to 31ft.

TAPPING A NEW MARKET

Each of the eleven airlines planning North Atlantic tourist services was faced with the problem of increasing aircraft-capacity without involving discomfort to passengers. That B.O.A.C. has solved the problem is proved by this interior view of one of its 68-seat "Mayflower Service" Constellations.

Eleven Airlines Open North Atlantic Tourist Services

LAST week may prove to have been the most momentous in the crowded post-war history of civil aviation. As described elsewhere in this issue, B.O.A.C. operated the world's first scheduled service with a jet airliner on May 2nd. Twenty-four hours earlier the whole basis of airline operations had been revolutionized by the inauguration of tourist services on the North Atlantic route. Months will elapse before it becomes possible to analyze the full effect of low-fare travel in the light of operational and financial statistics provided by the eleven airlines which, by agreement at the last I.A.T.A. traffic conference at Nice, are now operating these services. Meanwhile, however, it is appropriate to review briefly the implications of their decision.

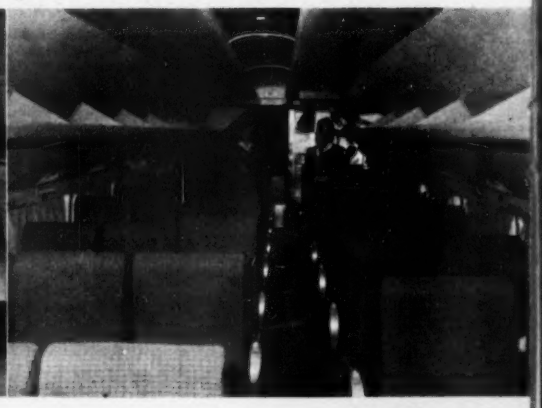
Tourist-class air services have been defined by one of the pioneers, Juan Trippe, president of Pan American World Airways, as "simply an application of the tested American principle of mass production—achieving a wider and wider market by lowering the unit price of the product." It was in the United States, undeniably, that large-scale tourist or "coach" services were first operated by the main airlines. The trend became apparent in 1948, when competition by "non-sked" companies, equipped largely with war-surplus transports, forced the big carriers to offer cheaper domestic services. Though several companies had previously advocated the principle of cut-rate services, their ability to apply the principle had been restricted by shortage of aircraft. The first company to receive C.A.B. approval for a cheap scheduled service was Pan American, which began tourist flights between New York and Puerto Rico in September, 1948. Thereafter, the proportion of coach to first-class or standard services increased rapidly. By the end of 1951, the nine American scheduled domestic carriers were operating 64 daily flights between 34 cities.

Pan American first broached the subject of introducing tourist fares on the North Atlantic routes at an I.A.T.A. traffic conference in 1948, but subsequent realization of the principle was slow. At another I.A.T.A. conference—in May, 1951—the airlines agreed to introduce "experimental" tourist services in October, 1952. The next conference (in London in September, 1951) discovered considerable differences between the airlines as to the fares to be charged. Pan American's delegate, vice-president Willis Lipscomb, then announced that his company proposed to begin $225 (single-fare) tourist services across the North Atlantic on April 1st, 1952, whether I.A.T.A. agreed or not. It can safely be assumed that the other main American airlines held a similar viewpoint; their domestic coach services had proved highly successful and the American Civil Aeronautics Board was by now giving full support to "air transportation for the many."

In the two months remaining before the next traffic conference —at Nice in November and December, 1951—the member-airlines with North Atlantic interests prepared for battle, as the "tourist" subject again headed the agenda. Pan American and T.W.A., who carried just over half of last year's 329,000-odd transatlantic "scheduled" passengers, were the most powerful advocates of cheaper fares, facing opposition mainly from the smaller European operators. B.O.A.C., as third-largest carrier on the North Atlantic route, encouraged by above-average expansion of its traffic, had no cause to oppose the introduction of tourist fares. The opposition was overcome and the conference ended with the unanimous agreement that services would begin on May 1st, 1952. Fares would be 30 per cent less than summer standard rate and 20 per cent less than off-season tickets—actual tourist return fares are £173 13s and £148 19s (winter), compared with the standard fares of £254 and £217 18s.

To make these reductions possible, of course, certain "luxuries" as found on first-class services had to be ruled out. Baggage allowance was reduced from 66 lb per passenger to 44 lb, and meals

Comparison between interior layouts offered to tourist passengers on B.O.A.C.'s 68-seat Constellations (left) and the Pan American Airways DC-6Bs which seat 82. The first East-West tourist flight (at 0001 hr on May 1st) was made by a Constellation of B.O.A.C.'s new "Mayflower Service."



"Flight" photograph

Clipper "Liberty Bell" at London Airport last week. Thirty-nine of these aircraft are going into P.A.W.A. service, the first nine having opened the Atlantic tourist service on May 1st.

would have to be paid for. Above all, the seating capacity of the following five types of aircraft employed on the services would have to be increased, I.A.T.A. having stipulated certain minima (shown in brackets): Constellation (59), DC-4 (55), DC-6 (60), DC-6B (77) and Canadair Four (40). A further economy, incidentally, is to be borne by travel agents, who will receive six per cent commission for cut-fare bookings—compared with 7½ for first-class tickets.

Since the I.A.T.A. decision, the Atlantic carriers have been busy planning their tourist schedules, having the necessary alterations made to their aircraft and—in some cases—taking delivery of new machines. Pan American plan to operate the greatest number of tourist services; they have already received over 15,000 bookings for the period May-July alone. Using 82-seat DC-6Bs (a flight in one of these aircraft is described hereafter), they will build up their services from an initial daily frequency to 15 weekly by August 1st. T.W.A.'s tourist Constellations, seating 60—one seat over the minimum—are also making seven flights weekly, and this frequency is being stepped-up to 12 by June 1st.

B.O.A.C.'s "Mayflower" fleet, consisting of five 68-seat Constellations, is committed to an initial weekly schedule of two flights between London and New York in each direction, one between London and Montreal in each direction and one from London to Boston and New York in each direction. The North Stars of T.C.A. will carry the minimum specified number of 40 passengers; this airline, which is operating a daily service in each direction between Canada and Europe, now carries only tourist passengers over the North Atlantic. Sabena has shown a more cautious approach and its three weekly transatlantic flights in each direction will be made by DC-6s equipped to carry 44 tourist and 16 first-class passengers in separate compartments. Swissair has not yet converted its DC-6Bs and DC-4s to full tourist-capacity and both types are carrying 50 passengers on initial weekly flights. The S.A.S. schedule of four flights weekly in each direction, to be doubled on May 25th, will be flown with 80-passenger DC-6Bs and 60-seat DC-6s. Temporarily equipped to carry only 48 tourist-class passengers, the DC-6s of L.A.I. (Italian Airlines) will operate one round trip per week. Air France is using 59-seat Constellations on its two tourist flights per week in each direction; this service will reach a daily frequency by June 15th. Another airline carrying the minimum specified number of tourists in its Constellations is El Al (Israel Airlines), who are making two flights weekly. K.L.M. are operating three flights weekly in each direction with 75-seat DC-6Bs.

As mentioned earlier, the total of transatlantic airline passengers last year was in the region of 330,000. Low-fare services may increase the 1952 figure to half a million or more, and the airlines can now look forward with confidence to overhauling the 700,000-passenger yearly average carried by sea. In Europe, also, cut-rate fares on a number of inter-city routes have already been announced, and operators are now making plans to extend their tourist services. Their aircraft, however, are equipped on a higher-density basis than the transatlantic airliners, and increases in seating-capacity are likely to be less spectacular than those on the North Atlantic services. The airlines are, in general, confident that—for some months at least—tourist services will not seriously compromise bookings for luxury-type air travel, and that the new services will prove profitable in themselves. For the average citizen, the inauguration of international tourist services is certainly a step in the right direction—even though, in Europe at least, the benefits of air travel may not be fully realized for some years.

RIDING the SUPER 6

ALMOST certainly offering more seat-miles per gallon than any other transport, the modified DC-6B, as delivered for the P.A.W.A. "Rainbow" services mentioned in the adjacent column, represents the culmination of 20 years' continuous development and is certainly a very useful vehicle.

Differences in external appearance between the DC-4 and this newest Douglas transport—dubbed Super-6 by PanAm—are not anything like indicative of the enormously increased potentialities of the newer aircraft. Both power and all-up weight have been almost exactly doubled while retaining the same wing area; landing speed rise has been arrested by the use of large double-slotted flaps and the Super-6 does not display any vices due to 75 lb/sq ft wing-loading.

Much attention has been paid to the front end of the aircraft. Two pilots sit in the nose with a flight-engineer in an occasional seat between them; no navigator or radio operator is carried. Radio equipment, however, is more lavish than on any other airliner we can call to mind, with the exception of the Comet. Largely duplicated, it includes V.O.R./D.M.E., 20-channel H.F., 50-channel V.H.F., 280-channel V.H.F. for I.L.S. and Omni-range, A.D.F., I.L.S. glidescope, Loran, marker-beacon receiver and Zero Readers and approach couplers. Remote radio control is available from a console between the pilots.

Seating for 85 passengers is provided in the tourist aircraft, the seats being of welded magnesium tube with rubber-foam cushioning. Average pitch is about 38in, seats being individually adjustable for inclination; all seats face forward and are stressed for 10g crash-loading. Further safety is provided by making the top of each seat-back from thin metal sheet, to absorb impact head-blows from the occupant of the seat behind.

That such tourist accommodation is by no means uncomfortable was amply brought home to the writer last week during a spell of some seven hours in Clipper *Liberty Bell*, one of the first of the P.A.W.A. Super-sixes. The only criticism he would make is to record disappointment in the armrests. Even when covered with yielding leatherette an armrest with an overall width of 2½in becomes painful after an hour and, for the Atlantic run, it is felt that broader rests could have been provided with little weight penalty and while preserving the seat width of 17in.

Flying qualities of the aircraft are, like those of previous "sixes," impeccable. An increase in weight of 7,000 lb over previous DC-6Bs—most of which is fuel—is not apparent from the sprightly behaviour of the aircraft, both on normal take-off and on overshoots. During the flight in question, numerous instrument and radio approaches were made at Amsterdam, Frankfurt-am-Main and Dusseldorf; on each, the effect of opening up the 10,000 h.p. available was remarkable, while flap could be taken right off without any appreciable sink being apparent.

Noise level and vibration are average for a modern airliner, both being high alongside the engines, but falling off to a comfortable level aft. The shaking experienced at the tail-end of some "Sixes" appears to be less noticeable in spite of the fuselage length of 106ft.

A miniature galley is installed, holding one pre-cooked meal and coffee for each of the 85 passengers; in the same general area abaft the main entrance are an ice-water fountain and coat-racks, while the two lavatories are on the line of the wing leading-edge, each

RIDING THE SUPER 6 . . .

being fitted with several wash-basins to handle the high-density load.

No "tunnel" effect is produced by the interior, probably thanks to the skilful selection of fabrics and colours. Seat covering of blue nylon fabric blends restfully with the cloth-backed plastic wall—grey up to window level and pale yellow above and over the ceiling; the curtains are of coral colour in a heavy wool. The over-all effect—of paramount importance on a long flight with tourist seating—is commendable.

Such high-density seating is bound to involve certain problems which do not appear capable of immediate solution; in particular, passenger movement tends to block gangways and produce queueing, while strain on stewards and stewardesses is greatly increased; equally, arrangement of emergency exits and life-rafts becomes more difficult. But the first of these are minor disadvantages when related to the greatly increased capacity available.

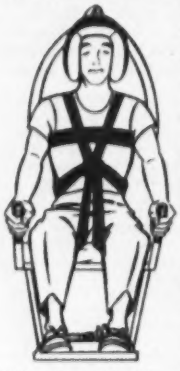
The "tourist" aircraft now entering service with several airlines appear to be the optimum blend of comfort with capacity and will undoubtably make air travel available to a hitherto untapped section of the public. May 1st, 1952, should, therefore, be recorded as being a date of as much consequence as the following day—which saw the Comet enter scheduled service. W.T.G.

STOPPING THEM IN THEIR TRACKS

THE Northrop aircrew-decelerator, details of which were published in *Flight* of February 9th, 1950, has now been in full operation for rather more than two years, and fully analysed results are now available to the U.S.A.F.

The apparatus consists, briefly, of a steel-tubular sled powered by three 1,000 lb-thrust rocket flagons and running on a rail-track provided with a special braking arrangement at one end. It has been built at Edwards A.F.B., Muroc Dry Lake, California, and the testing has been conducted under the auspices of the aero-medical laboratory of the Wright Air Development Centre at Dayton, Ohio.

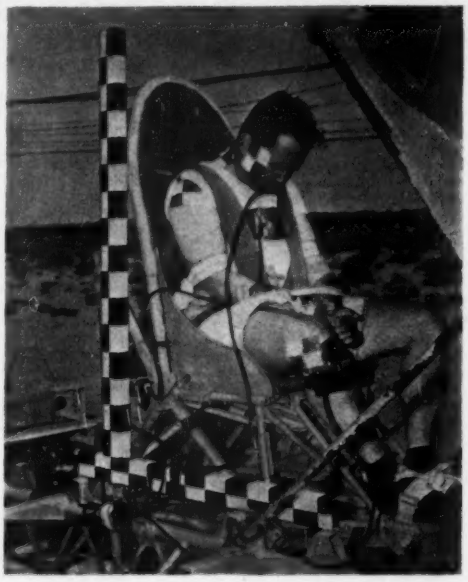
With all three rockets in use, the sled reaches a speed of about 170 m.p.h. in 500ft. Power is then removed and the unit allowed to coast until the arresting section of track is reached at about 154 m.p.h.; various degrees of braking are applicable, the most severe slowing the sled to 34 m.p.h. in a distance of 31ft in about 0.228 sec.



Major John Paul Stapp, a U.S.A.F. medical officer, has carried out most of the test-runs. The maximum deceleration he has so far experienced is reported to have been 45 g; this would result in his apparent body-weight becoming some 7,900 lb. As shown in the accompanying photograph—which portrays Major Stapp himself—unusually complete harness has been used on the test-runs, both the feet and hands being shown strapped down tightly.

Maj. Stapp (right) is seen to be fully instrumented with heart-beat and blood-pressure recorders; reference points on his body are marked by camera targets. The sketch (left) shows the U.S.A.F. pilot-harness developed from these tests.

A new pilot-harness has emerged from these tests; the sketch shows it to include a foot-strap into which the pilot apparently inserts his feet immediately before an expected impact is felt. Finally, reports from the Aero-Medical laboratory speak highly of aft-facing seats; these are stated to provide "a maximum of protection with minimum harness," but no indication is given whether or not such seating is considered possible for a pilot.



ROTOL AND THE FUTURE

SPEAKING at the recent annual prize distribution to apprentices of Rotol, Ltd., Lt.-Gen. Sir John Evetts, C.B., C.B.E., M.C. (managing director) said the company had great faith in its plans. "We have not been idle in thinking out future projects," he added, and went on to remark that a lot of people had said that the propeller-driven aircraft was "dead and buried," but he personally did not believe it—"If for purposes of economy of operation the reciprocating-cum-turbine composite engine, such as the Napier Nomad, becomes fashionable, then I foresee considerable use of propeller-driven aircraft in civil aviation."

Earlier, Sir John had dealt with the company's more immediate prospects, stating that Rotol would be involved in the field of component parts and accessories for all the aircraft which the Government had decided should have super-priority.

Speaking of the apprentice scheme, Sir John said that the number of apprentices at present being trained was 130, and it was proposed to increase this number to 150 or more by the end of the year. To accommodate the increase, alterations had been carried out on the training school buildings and additional machine tools installed.

Among the winners of Higher National Certificates in Mechanical Engineering was R. W. Partridge, who gained distinctions in thermodynamics, strength of materials and theory of machines, as well as the Institution of Mechanical Engineers National Certificate Prize.

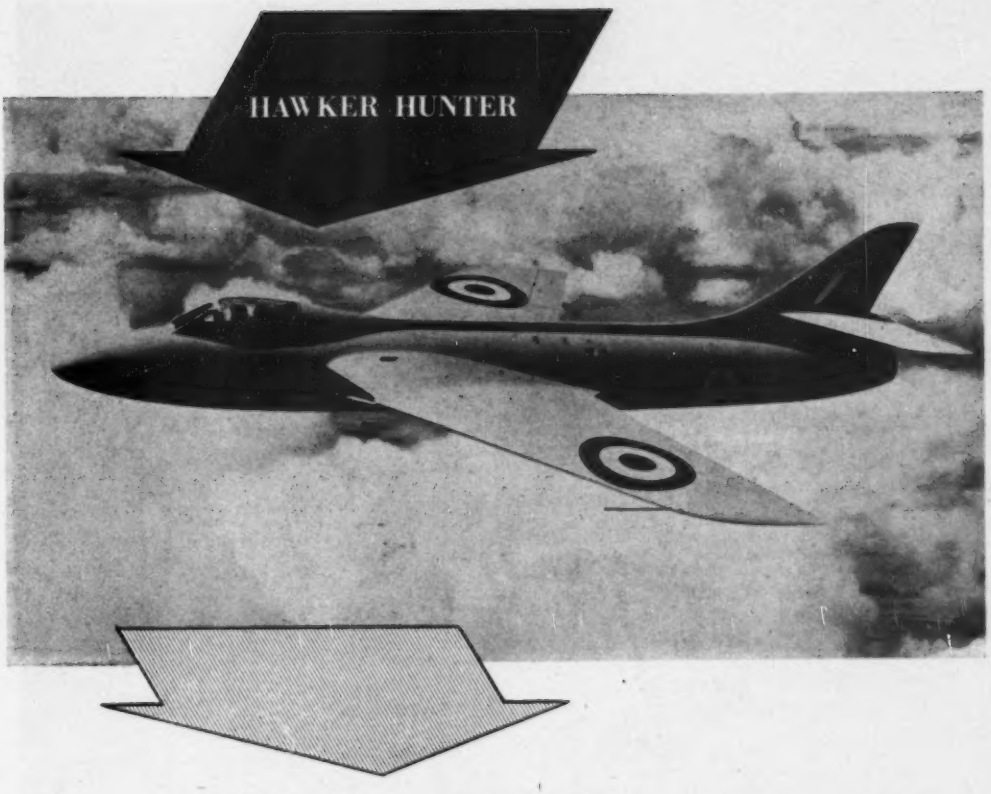
Higher National Certificates in Mechanical Engineering were also won by G. C. G. Agg (distinctions in strength of materials and structures, and in aircraft design, and an endorsement in mathematics); Mrs. G. Agg (endorsement in mathematics), D. N. Birrell and P. Wilson.

Other successes in the National Certificate examinations were as follows:

Higher National Certificate in Electrical Engineering: B. G. Beard, R. C. Williams. Higher National Certificate in Production Engineering: M. J. Stevens. Ordinary National Certificate in Mechanical Engineering: M. W. Chambers, C. R. Hambling, I. R. Harris, C. G. Walker. City and Guilds of London Machine Shop Engineering—Final Certificate: P. B. Hopkins; Intermediate Certificate: D. G. Cameron, P. G. Newing, T. P. Parker, F. J. Robertson; Higher National Certificate A.1: L. Kelly: Ordinary National Certificate S.2: D. T. Shellswell, R. B. Whiteley; Ordinary National Certificate S.1: P. B. Barnes, R. T. Roderick; Supplementary Endorsements to the Higher National Certificate: R. Hayward and T. J. Sullivan (Industrial Administration).

DEFENDING THE CANBERRA

A HOUSE-ORGAN of the English Electric Co., Ltd., includes the following reference to the Canberra which recently flew out to Australia: ". . . it is to be used exclusively for secret work on the Woomera range. It will be a guinea-pig for new guided-missiles which cannot be tested properly by piston-engined bombers. It will also experiment with secret radar equipment for defence against guided-missiles, and has been fitted with radar bomb-sights that can be used at very high speeds."



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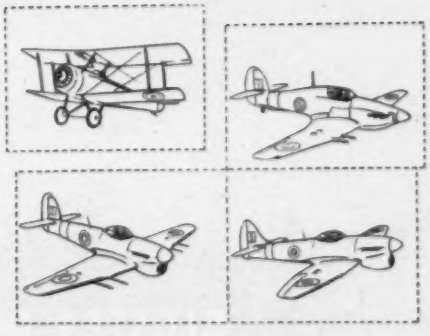

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Those South Kensington Murals

HOW very right is Mr. C. Rupert Moore (May 2nd) when he criticizes the murals which deface the entrance to our National Aeronautical Collection in South Kensington. One might accept abstract or even surrealistic designs if they showed that the artist had some feeling for aviation, which, after all, is a subject right enough in formal relationships—or whatever it is artists look for. But the pictures on the Kensington walls are badly drawn and illustrate nothing but the artists' inexperience.

Here is a suggestion to those responsible for reorganizing the Collection. Having cleaned up the scene of the crime with whitewash, let them announce through the pages of *Flight* an open design-competition for new murals. The final choice should be made on the decision of a committee representing every branch of British aviation.

London, N.W.3. ROGER BAKER.

Memories of the D.H.18

I WAS rather surprised, in reading my *Flight* of April 25th, to see the page given to that product of the de Havilland people not long after World War I, the D.H.34.

Far more significant, from the viewpoint of air-transport history, was that truly wonderful machine—the forerunner of *all* aircraft for airline use—the D.H.18.

I was working as personal assistant to Mr. Holt Thomas when the organization which he founded, Aircraft Transport and Travel, took delivery of the first of their D.H.18s, in, I believe, the summer of 1920. At that time we were using war-converted D.H.4s, 9 and 16 types at the old Croydon Aerodrome, on the Plough Lane side, while Handley Page at Cricklewood were operating their war-converted bombers. Therefore, when the first D.H.18 came over to us (I was on the aerodrome on the day of its arrival) it was actually the first of all purely transport-type passenger aircraft to come into regular service on the pioneer British airways. I also reckon it may very well have been the first purely transport machine to operate on any of the world's airlines.

Its performance, judging by the standards of those days, was truly remarkable. With one 450 h.p. Napier Lion engine it carried a pilot (in a rear cockpit) and, in an enclosed saloon with really wide-outlook windows, it provided quite luxurious seating for eight passengers. With this load, on its one engine, it flew at a maximum of 122 m.p.h., and cruised on its flights between London and Paris at 105 m.p.h.

Epsom, Surrey. HARRY HARPER.

[The object of the article "Historical Parallel," in our special Comet Number, was to call attention to the fact that another famous de Havilland type, the D.H.34, had gone into service with B.O.A.C.'s predecessors almost exactly 30 years earlier.—ED.]

Unorthodox Configurations

I WAS very interested to read, in recent issues, letters referring to the Delanne tandem monoplane. It was claimed for this French fighter that it was completely stall-proof, had a wide speed range and was aerodynamically efficient. But is there not a British project which has just these qualities coupled with other advantages not possessed by the Delanne type?

I refer to the Warren-Young aeroplane, which has been described several times in the aeronautical Press during the past ten years. I believe that the Warren-Young wing form was first suggested by Mr. Hall-Warren about 25 years ago and was further developed and incorporated into an aeroplane about 15 years ago, when Mr. Rex Young joined with Mr. Hall-Warren in conducting successful experiments with free-flight models. Subsequently an aircraft design was completed by Mr. Hall-Warren and patents were secured. It appears, therefore, that Mr. Hall-Warren's aircraft predates the Delanne by many years.

The characteristics of the design are as follows:—

(1) The stall, as commonly understood (i.e., associated with instability and loss of control) cannot occur.

(2) The slow onset of burbling, coupled with maintainance of trim and stability, will mean that the aircraft can descend parachute fashion, in a nose-up attitude at a very low forward speed.

(3) The development of an exceptionally high maximum lift coefficient at a large angle of attack will result in a very low minimum level speed and a wide speed range.

(4) The disadvantages inherent in both swept-forward and swept-back wings, which are of opposite character, are cancelled out by the employment of both.

(5) The large tip surface which is common to both front and rear surfaces is identical in effect to inverse taper, which is the only satisfactory cure for the tip stalling of swept-back wings, but which in orthodox wings is structurally highly disadvantageous.

(6) Due to the connection of the front and rear wings, the structure is exceptionally stiff and torsionally rigid, and this effect, coupled with the small span resulting from the tandem formation of lifting surfaces, means that the specific strength is high and therefore the structure weight low.

(7) The Warren-Young Skycar layout illustrated in *Flight* of August 10th, 1950, is an advanced design possessing advantages apart from the wing. The placing of the propeller at the after end of the aircraft has the obvious advantages of increasing propulsive efficiency and decreasing body drag, in addition to improving the comfort of the pilot and passenger by elimination of slipstream buffeting and reduction of noise and fumes in the cabin. There is also the advantage of an unobstructed field of vision.

Cheltenham, Glos. E. VOSS.

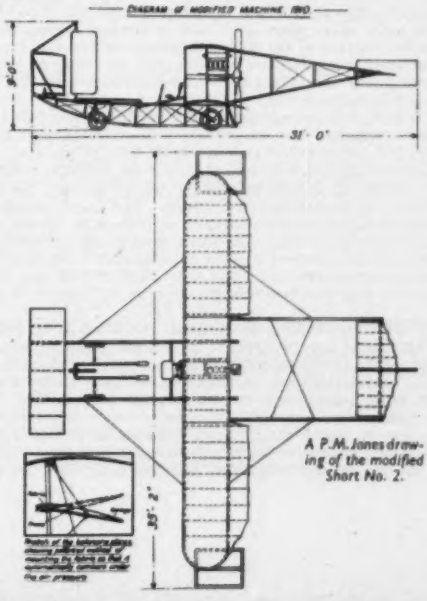
THE FIRST AIR DRAUGHTSMAN

THE death recently took place, in Rochester, Kent, of Percy Muir Jones. Aged 67, Mr. Jones was able, with justification, to lay claim to being the world's first aeronautical draughtsman, for in the year 1907 he joined the Short brothers, then engaged on the construction of balloons at Battersea. With them he transferred to Leysdown, and there, as their draughtsman, he drew up the plans for the six machines which were built by Shorts to the design of Wilbur and Orville Wright. These drawings were, incidentally, the first properly completed drawing of this, the first aircraft ever to fly. Before P. M. Jones was assigned to the task, even the Wright brothers themselves had not made detailed plans.

The passing of "P.M.", as he was affectionately known, thus severs an irreplaceable link with those early pioneering days. From 1908 onwards (writes a member of Short Brothers and Harland, Ltd.) he was a member of this company's technical staff for almost forty years, and in 1915 became its chief draughtsman. Before his retirement in 1948, P. M. Jones filled the post of librarian, and his many reminiscences of the growth of the aeronautical industry were a source of much interest to those privileged to hear them.

Educated at Mill Hill School and London University College, it was to this latter institution that P. M. Jones returned when, finding retirement irksome, he became librarian to University College Engineering Faculty. Only a few weeks ago he presided at the annual dinner of the Short Brothers "25 Years Plus" Association, of which body he was chairman and a founder member.

Those who knew P. M. Jones were confident that his engaging personality and invaluable experience would be with us for many more years, and his death comes as a distinct shock.



A P.M. Jones drawing of the modified Short No. 2.

Commercial Aviation Commentary

By HENRY MORRIS

"THE Great Fare Muddle." This sort of thing is becoming a familiar headline in the British popular Press these days, and it seems that a modified version may soon be appearing in the international Press in regard to air fares. "The Great Air Fare Scare" sounds a likely guess.

The international operators are only just recovering from the hurly-burly of the I.A.T.A. controversy over tourist fares. (Officially, there was no controversy, so perhaps we had better say "extended negotiations.") They are now all agreed that the new traffic which will be attracted by a substantial reduction in fares will be so heavy, and the passengers so content with a less luxurious but higher density seating arrangement in aircraft, that the greatly increased load-factors and overall volume of traffic will much more than offset the lower earnings per passenger-mile.

Unfortunately, coincident with the inauguration of international tourist air fares the "slump on the way" signal has been hoisted. At the same time, the greatly increased flying involved in the growing introduction of tourist services has created its own shortages and scarcities—apart from the shortages already developing as a result of the accelerated security programme. Thus operators have had to face heavy all-round increases in almost every item in their costs, and British operators in particular are being penalized by the loss of Abadan and the consequential rise in fuel prices.

♦ ♦ ♦

AMERICAN domestic operators have reacted quickly to this situation and have applied to C.A.B. for permission to raise their tariffs by varying amounts averaging out at about 5 to 6 per cent. This applies not only to the long-established domestic operators but also to the latest newcomers in the "low-rate high density" field, such as the all-freight carriers Slick Airways. C.A.B., however, are not inclined to over-sympathetic rulings in favour of the operators and they prefer to err on the side of giving the public the benefit of the doubt. Their attitude is likely to be followed by many other authorities throughout the world; it seems to be roughly this: "The air companies have been making very good profits over the last two years. The airlines calculated that the 'low-rate high-turnover' policy would increase those profits. The volume of traffic they have generated has unexpectedly exceeded the estimated rate of increase in their capacity. Their costs have certainly risen, but this was foreseen. Thus the airlines may be seizing on the excuse of increased costs to raise rates again to fill existing capacity at these higher rates, and will then lower the rates again when their new equipment comes along. In the interests of the public, therefore, we, the C.A.B., will not agree to any increase in tariffs until the return on investment looks like falling below our maximum safe figure of 8 per cent as opposed to the current figure of about 20."

The C.A.B. are apparently also bearing in mind that the new equipment now on order will increase the capacity of the U.S. air-transport industry by at least 50 per cent. and that this capacity will be filled only if the operators continue to secure an increasing slice of the lower-tariff category traffic—both passenger and freight. The C.A.B. no doubt feels that any increase in rates at this stage would start flattening-off the slope of traffic increase, so that the operators might find themselves in financial difficulties when their new equipment comes along, and the C.A.B. would once more have to deal with heavy claims for more and more mail pay.

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THESE interlocking problems are paralleled in the British industry; but, by virtue of the secrecy which has become part of the traditional atmosphere in which British air transport operates, little is known about the many thoughts that are being concentrated on this involved subject. The Corporations have now allied themselves to the theorists who believe in "lower costs, higher turnover," but clearly they were very hesitant to begin with and even now must play for a go-slow attitude because of their own equipment position. There is no doubt that, for example, traffic to and from the Continent could be increased dramatically if greater capacity was let loose on the Continental routes; but B.E.A. have been hamstrung by the delays in delivery of their new aircraft and, also, have not been anxious to let the British independent operators in on any of their Continential services—even though those operators have steadily maintained, and still do, that they could operate many tourist-class services profitably at lower fares than the current B.E.A. level.

It seems that B.E.A. have succeeded in deferring any large-scale introduction of the tourist rates on the European services until the end of this current summer season. Presumably, therefore, it would have been economic for them to do so at the beginning of the season if they could have coped with the traffic that would have developed. Yet it is probable that, if they wished, they could sign up for 15 to 20 chartered aircraft to support their own fleet and so give the public the benefit of cheaper air transport during the coming season. There are always counter-arguments against such ideas, and B.E.A. will probably answer that with the restricted travel allowance the traffic just is not there. The answer to that, in turn, would be that the traffic is still going by surface transport and the air companies are still only absorbing a comparatively small percentage of the total.

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THIS takes us on to the big slump scare. Already many American experts are warning the air companies that the slump will probably be in full swing by 1954-55 and will coincide with the peak deliveries of new equipment. But although the operators are still licking their wounds from the 1947-48 slump, they are sufficiently young and optimistic to refuse to be panicked into any drastic cancellations of equipment orders. They no doubt suspect that these dismal forecasts are to some extent promoted by rail and coach interests, who have been severely shaken by the tremendous inroads into their traffic made by the U.S. domestic operators.

The jackpot question is: would a general slump hit the British operators hard? If it was a slump of such magnitude that trade was stagnated and the country was virtually bankrupt—or more bankrupt than it is at present—then air transport would be badly hit; but so would every other form of business. If it is only a slump in the sense of a comparatively severe trade-recession, followed by the usual elements of unemployment, higher taxation, and so on, the effect on air transport might be just the reverse. Traffic *has* been artificially restricted because of lack of carrying equipment, so that at present a large proportion of the traffic is still in the "luxury" class. A slump might severely reduce passenger travel and freight movement, but it would not eliminate it altogether; and air transport would, by virtue of the decrease or disappearance of the "luxury" air traffic, be forced to go out for the lower categories of traffic now on the verge of switching over to air transport.

This switch might thus be accelerated by a reduction in some of the basic airline costs, such as labour, fuel, and other materials, which in conditions of slump might be more readily available at a lower price than at present. A slump also brings continuous and rapid changes in trading techniques and it is in such conditions that air freighting might find itself in greatest demand.

So two questions now being most anxiously studied in British air transport circles are: do the continued inflationary trends make it necessary to revise plans for an accelerated introduction of lower tariff services? And will a slump, if it comes, paralyse the air transport industry?

The consensus of opinion seems to be, firstly, that the introduction of tourist-class services and intensified low-tariff air freighting should be accelerated rather than slowed down and, secondly, that if the new pattern for air transport (i.e., its adoption as a normal rather than a luxury form of transport) can be well set before any slump looms up, then the industry should not be badly hit.

CIVIL AVIATION

COMET PASSENGERS board their coach—appropriately decorated for the occasion—at the outset of B.O.A.C.'s first jet service to Johannesburg.

THE SILVER WING AGAIN

HOW many people today, we wonder, realize that the first "named" air service in the world was the famous Silver Wing of Imperial Airways? This great British institution was inaugurated on Friday, April 29th, 1927, and the "spotters" of the day will remember that the Armstrong Whitworth Argosies employed were specially repainted and picked out with very dark blue lining and lettering. (Formerly the colour scheme had been silver wings and tail units and dark blue fuselages.) The service established a literally world-wide reputation for comfort, convenience and courtesy, and it is fitting that not only its name but its spirit should now be revived by British European Airways.

The proving flight for the new service, which is, of course, to be operated by Elizabethans, was on April 30th—almost exactly a quarter of a century after Capt. Gordon P. Olley set out on the inaugural flight from Croydon in the Argosy *City of Glasgow*. In those days the service was timed to leave Croydon and Le Bourget simultaneously at 12 noon, and the fare was 6 gn single and 11 gn return, as compared with the normal rates of 5 gn single and 10 gn return. Stewards were not then carried on normal Imperial Airways services, but with the Silver Wing a bar was introduced, with a steward who really knew his job.

The revived B.E.A. service will leave London and Paris simultaneously at lunch time every day after June 9th and will be timed to take 1 hr 30 min. This is by no means the fastest possible by Elizabethan, but has been so arranged to give the stewards an opportunity of providing their best attention. The aircraft will be standard 47-seaters, but only 40 passengers will be booked for each trip. There will be no supplementary charge, though a special hot luncheon, with champagne, will be offered, and two stewards and one stewardess will be in attendance.

FERRY NEWS

BRISTOL Freighters of Silver City Airways will operate a Blackpool-Isle of Man ferry service to carry cars, motor-cycles and cycles during the two or three days immediately before and after the T.T. motor-cycle races. Passengers will be carried only if they accompany vehicles and the service will thus not compete with operations by the Lancashire Aircraft Corporation. (L.A.C., incidentally, will be responsible for ground-handling the Freighters at Squires Gate, Blackpool). Single fares will be: Large cars, £21; small cars, £13; motor-cycles, £4 10s; bicycles, £1. Passengers accompanying vehicles will pay £4 5s return.

Silver City recently inaugurated its third regular ferry service—between Southend and Ostend. The company has also been undertaking an increasing number of charter flights, typical cargoes being lettuce, furniture and export cars (over 300 have already been ferried this year.) Charter flights will form a greater proportion of Silver City's work in 1952; the reduced travel-allowance will retard expansion of the private-car ferry service, which carried over 8,500 vehicles across the channel last year and was originally hoped to transport over 13,000 in 1952. Silver City's plans for next year include the introduction of their "long-nosed" Bristol Freighters built to carry three cars and 20 passengers (the normal capacity of their present aircraft is two cars and 12 passengers). The first of six on order from the Bristol Aeroplane Company will, it is hoped, be ready for display at September's S.B.A.C. Show.

TWO IMPORTANT DISCUSSIONS

ALL aspects of (i) final approach and landing and (ii) airborne radio equipment are being discussed at the latest I.A.T.A. traffic conference by some 200 representatives of airlines and other interested organizations. The conference, which is being held at Copenhagen, began on May 5th and will end on May 17th.

The approach-and-landing discussions, which are being held in close session, will try to analyze "not only the individual phases and specific aids used in this critical stage of flight but also the complex relationships and links between them." I.A.T.A. hopes that the final report will point out ways of increasing the chances for successful landings under marginal conditions, to suggest "missing links" between phases of approach and landing and to develop new operational requirements. Airborne radio is the subject of a three-day symposium, from May 15th–17th, on the same pattern as the 1950 jet-transport discussion. The special problems raised by the use of jet airliners are, of course, being considered in both discussions.

RAMSGATE TO RE-OPEN

OPERATED in pre-war days by Whitney Straight Aviation, Ltd., but closed since 1939, Ramsgate Airport is to be re-opened in June by Air Kruise, Ltd. In association with B.E.A., Air Kruise are extending their Lympne/Le Touquet services to Ramsgate in order to serve a large population in the Thanet area. The company is taking a long lease on the airfield from the Ramsgate Corporation and the hangars and terminal buildings, damaged during the war, are being re-built. There are grass runways of nearly 1,000 yd which are considered suitable for aircraft of up to Rapide, Anson and Heron weight. At first, Air Kruise will be the sole operator, but the airport will later be open to charter and private operations, and there will be fuel and maintenance and—eventually—restaurant and club facilities. There are no Customs arrangements yet, but Air Kruise hope that a permanent officer will shortly be stationed at Ramsgate.

FOR AULD LANG SYNE: Two men look to the past, another to the future: a sentimental moment at London Airport on April 30th, on the occasion of B.E.A.'s Silver Wing proving flight, subject of a news item on this page. Upholder of the Argosy (left) is, of course, Captain Gordon P. Olley, pilot on the very first Silver Wing flight by Imperial Airways; centre is Mr. H. Dowson, a steward on the original service, and still—at 78—in B.E.A.'s service (bravo Mr. Dowson!); and, right, B.E.A.'s youthful chief executive, Peter Masefield.

CIVIL AVIATION . . .

B.E.A. TO BASLE

ON Friday, May 2nd, for the first time since 1939, a British airline service was operated from London to Basle. It was Handley Page Transport, Ltd., who pioneered the first British service from London to Paris, Basle and Zurich, using an H.P. O.10; the date was August 16th, 1923. In June, 1924, Imperial Airways opened the service which continued until the war. Now B.E.A. have resumed the service. For this month they will be offering a thrice-weekly schedule, but from June 1st there will be daily flights (except on Wednesdays) until September 19th, after which the service will revert to three flights a week.

Although the scheduled flying time is 2 hr 48 min for the outward journey, and 3 hr for the return trip, Friday's inaugural flights (in Viking G-AJJN *Sir Charles Napier*) were slightly ahead of schedule.

As its official name, Basle-Mulhouse, implies, this airport serves both Switzerland and France. Although in French territory, it is only 2½ miles from the frontier, and about seven miles from the town of Basle. A Customs road is under construction, so that passengers who so desire may pass directly into coaches and proceed straight to the Swiss frontier without entering French territory. Administration of the airport is in the hands of a council with both French and Swiss members, and during the reception held to mark the occasion, the Swiss director of the council, Lt.-Col. Charles Koepke, made a speech of welcome.

A SYCAMORE TOUR

A BRISTOL Type 171 Sycamore helicopter is due to leave Filton on May 11th for a 1,400-mile sales tour of the Low Countries and Scandinavia. The pilot will be C. T. D. Hosegood, and flying with him will be Mr. A. G. L. Langfield, technical sales representative, and an engineer. Mr. W. R. Farnes, sales manager of Bristol's Aircraft Division, will follow the same route by airliner.

Prior to leaving Filton, Mr. Hosegood will have collected letters from the Lord Mayor of Bristol addressed to the mayors or principal officers of the towns along the route. Having cleared Customs at Lympne, he will make the 155-mile cross-Channel flight to Brussels. Thence the itinerary will be the Hague (May 14th), Hamburg (May 16th), Copenhagen (May 18th), Oslo (May 21st), and Stockholm (May 24th). At each point demonstrations will be given before military and civil authorities. The Sycamore will return to Filton from Stockholm on May 28th in a Bristol Freighter of Silver City Airways.

BREVITIES

BELIEVED to be the greatest number to have flown the Atlantic in a civil aircraft, 87 passengers arrived at Shannon last Friday on a Pan American "Rainbow" DC-6B. A crew of eight was also aboard.

* * *

Mr. Reginald Maudling, M.P., who was recently appointed Parliamentary Secretary to the M.C.A., served in the R.A.F. and was a private secretary to the Secretary of State for Air.

* * *

A recent photograph in *Flight* showed the interior of a Central African Airways Viking modified to carry 27 instead of 21 passengers. The caption, based on material supplied by C.A.A., gave a misleading impression of the part played by Airwork, Ltd., in modifying the aircraft; this company was, in fact, responsible for the main work of conversion.

* * *

Flown by G/C. Douglas Bader, D.S.O., D.F.C., a second Percival Prince is on its way to join the Shell Petroleum Company's oilfield fleet (a Prince and Sea Otter) in British Borneo. Initially, it will be based at Lutong, near the refinery, but will later operate from a new airstrip near Seria, the largest single oilfield in the British Commonwealth.

* * *

Sabena is the first operator to introduce cut-rate fares on international routes to Central Africa. By July 1st, the company will be operating nine weekly services from Brussels to Leopoldville; one of them will continue through to Johannesburg—connecting London and Johannesburg *via* Brussels in 26½ hr.

* * *

The demand for information on the new cut-rate services is fully met by the current volume of the A.B.C. World Airways and Shipping Guide (April 20th-May 14th) which is described by its publishers as the only guide giving full particulars of both tourist-class schedules and tariffs.

* * *

I.C.A.O. announces the publication of an aeronautical lexicon defining 2,500 aeronautical terms in English, French and Spanish.

* * *

Turnover at the I.A.T.A. Clearing House in London during February totalled over £5,330,000—compared with some £3,665,000 for the same month of 1951.

* * *

Mrs. E. Whittaker, secretary of the British Independent Air Transport Association, is leaving to join the Lancashire Aircraft Corporation as London manager and assistant to Mr. Eric Rylands, managing director of L.A.C.

* * *

T.A.E. inaugurated on April 27th a regular bi-weekly Dakota service between Athens and Munich/Frankfurt *via* Belgrade. The service is the first to be flown between Greece and Western Germany by a Greek airline.

* * *

Mr. Cecil Capel, M.B.E., A.R.Ae.S., is shortly leaving for Melbourne to take up an appointment with A.N.A. On behalf of the Armstrong Siddeley Company, which he joined after service with the R.F.C. in World War I, he has acted as a technical adviser to the Australian, Canadian and Netherlands Government. He accompanied Sir Alan Cobham on his historic Australia-England flight in 1926.

* * *

Following investigation into recent crashes, the U.S. Civil Aeronautics Board is extending to non-scheduled airlines certain pilot-proficiency regulations already applying to regular carriers. Each company will have to appoint a chief pilot, responsible for flying proficiency in the airline, who will undergo thorough periodic training courses. The U.S. Airline Pilots' Association, also moved to action by recent crashes, has pointed out that some 450 airliners used on long over-water routes carry life-saving equipment which is not readily available in an emergency; A.L.P.A. recommends the compulsory provision of improved safety equipment.

THE COMET'S CREW on the London-Rome stage of the inaugural service to Johannesburg: (left to right) Capt. A. M. Majendie, F/Off. J. G. Woodill, Eng/Off. W. L. Bennett, Rad/Off. R. W. Chandler, Steward E. W. Charlwood and Stewardess J. P. Nourse.

"Flight" photograph

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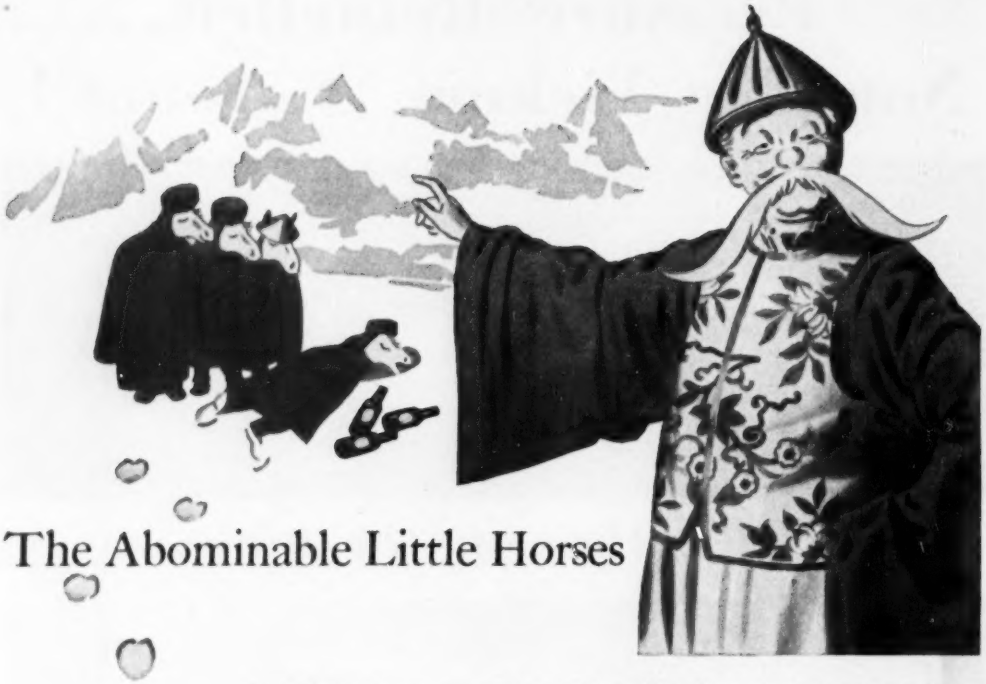

The Abominable Little Horses

"Abominable Snowmen" my foot—said the M.D. They are merely my Little Horses undergoing one of our usual tests. First they run up to the top of Everest and then they run down again backwards. This we call the *Rarefied Atmosphere Test* (Going and Coming). In other parts of the world my Little Horses are on test in deserts *(Coolth)*, under water *(Humidity)* and in Underground Railway Carriages *(High Pressure)*. Also in Selected Government Departments *(Cutting Red Tape)*.

I strongly resent these attempts to capture my Little Horses, particularly by intoxicating them with *Chang*, which I understand to be a sort of Tibetan Barley Beer. In short—shouted the M.D. suddenly turning deep purple—I will thank all Abominable Climbers and Abominable Explorers and all other Abominable Busybodies to ***Leave My Little Horses Be.***

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FLYING CLUBS and the FINANCE BILL

AN interesting debate took place in the Commons on April 30th, when consideration was given to the Budget petrol-duty proposals and their effect on flying clubs. Several Members had tabled an amendment to the effect that the tax should apply "except that in the case of aviation spirit supplied for the use of flying and gliding clubs duly authorized and approved by the Minister of Civil Aviation the rate of duty shall be ninepence a gallon."

The amendment was withdrawn after Mr. J. Boyd-Carpenter, Financial Secretary to the Treasury, had reminded M.P.s that he had replied in the affirmative when asked on April 4th whether the Chancellor of the Exchequer was prepared to extend the arrangement made last year to relieve the civil flying clubs of the increased petrol duty. Several Members, nevertheless, took the opportunity to stress the national value of the flying-club movement.

Moving the amendment, Mr. Frank Beswick (Lab., Uxbridge) stressed the difference between those who spent their spare time in flying and those who walked or cycled. In time of war, he said, a person who could fly was in a position to help the country more than the cyclist, as such. Similarly, in peace time, the more people could spend their time in the air, the more likely we were to throw up an individual of genius who would spur us on in our progress. Sir Wavell Wakefield (Con., St. Marylebone) suggested it was one of the vital interests of this country that every possible encouragement and opportunity be given to our young people to glide and fly. Everyone knew that with rising costs the opportunity was becoming increasingly difficult. He thought the amendment would not cost the Treasury very much, but it would mean a great deal to the clubs, many of whose members were young people with very little money to spend, and for whom any help would be a great advantage.

A. Cdre. A. V. Harvey (Con., Macclesfield) said the flying clubs, which had existed for something like 27 years, had done nothing but good. Flying and gliding had always been an expensive hobby but, nevertheless, the situation had improved recently in that organizations like the London Passenger Transport Board had their own flying clubs. A. Cdre. Harvey then recalled the days of the pre-war Civil Air Guard. Many people had laughed at it, but when war came it included hundreds of men who not only flew under active service conditions but who also delivered aircraft in Transport Command. The C.A.G. had, in fact, paid a tremendous dividend. Credit for that rested not only with its younger members, but also with men of over 50 years of age. He stressed that, apart from the defence aspect, the flying clubs were helping to make the population air-minded.

If ever this country had an opportunity of building up a large merchant air service, now was the time. It was happening in the U.S. and Canada, and already there were indications in this country that we had got to move very rapidly indeed if we were going to do something in the air as we had done with our merchant marine. He thought any concession to the flying clubs would be small compared with the very large sums spent on defence, and it would produce a much greater contribution than was generally appreciated.

Mr. John Grimston (Con., St. Albans) drew attention to the Government's statement of April 4th. He wanted to assure the Financial Secretary that those who tried to "keep their hand in" in civil aviation were very grateful indeed that the efforts of flying clubs were being recognized.

Replying to the debate, Mr. Boyd-Carpenter said it was in fact the intention of the Government to follow last year's procedure and by way of a grant to compensate approved flying clubs for the increased petrol duty. The cost of this concession would be some £9,000 in the present financial year, and £11,000 in a full year. He said the Government did accept what had been said as to the valuable purpose served by these clubs.

FOUR-CATEGORY R.Ae.C. CERTIFICATES

AS an incentive to private pilots and as a recognition of piloting experience, the Royal Aero Club is to introduce, on June 1st, four categories of Pilots' Certificates (to replace R.Ae.C. Aviators' Certificates). The respective qualifications necessary, beginning at the most elementary category, are as follows :—

Fourth-class Certificate.—25 hours' flying as pilot in command; one flight as pilot in command to a point not less than 75 miles from base. Alternatively : The holding of an R.Ae.C. Aviators' Certificate issued between January 1st, 1940, and May 31st, 1952.

Third-class Certificate.—50 hours' flying as pilot in command of a private or club aircraft; evidence of landing at five different airfields; one flight as pilot in command to a point not less than 100 miles from base. Alternatively : 200 hours' flying as pilot in command of any type of aircraft; or the holding of an R.Ae.C. Aviators' Certificate issued between January 1st, 1919, and December 31st, 1939.

Second-class Certificate.—125 hours' flying as pilot in command of a private or club aircraft; evidence of landing at ten different airfields; two hours' dual instrument-flying of which one may be on a synthetic trainer; one flight as pilot in command to a point not less than 200 miles from base; one flight involving Customs clearance; flying experience as pilot in command of three different types of civil aircraft. Alternatively : 500 hours' flying as pilot in command of any type of aircraft; or the holding of an R.Ae.C. Aviators' Certificate issued between January 1st, 1915, and December 31st, 1918.

First-class Certificate.—500 hours' flying as pilot in command of a private or club aircraft; evidence of landing at 20 different airfields; ten hours' dual instrument-flying, of which five may be on a synthetic trainer; one flight as pilot in command to a point not less than 750 miles from base; one flight involving Customs clearance; flying experience as pilot in command on five different types of civil aircraft including a twin-engined aircraft, an aircraft with retractable undercarriage, and an aircraft with variable-pitch airscrew. Alternatively : 2,000 hours' flying as pilot in command on any type of aircraft, or the holding of an R.Ae.C. Aviators' Certificate issued between March, 1910 and December 31st, 1914.

Applications for these Certificates must be made on an official application form to the Royal Aero Club, Pilots Certificates' Department, 19 Park Lane, London, W.1, or through an R.Ae.C. Official Observer. Logbook or other evidence will be required to substantiate claims.

Holders of a lower-grade certificate who qualify for a higher grade must return their certificates to the R.Ae.C. for endorsement. The cost of a certificate (including postage) is (with one endorsement), 15s; for subsequent endorsements, 5s.

A diploma (5s) and a neck-tie (10s) will be available for each grade of Certificate. The ties have a royal blue background and bear a number of gold stripes varying with the category. Scarves may also be obtained, 54 in by 10 in, priced 17s 6d each.

WEST LONDON TROPHY AIR RACE

DURING the weekend of May 3rd-4th, the Vintage Aeroplane Club held its second rally—an event considerably marred by bad weather but, nevertheless, carried off with enthusiasm typical of this newly formed club.

By 1100 hr on Saturday, the weather—which had been particularly fine earlier—had deteriorated to such an extent that the items scheduled for the morning were postponed until after lunch. Only three of the machines entered for the West London Trophy Race had so far arrived. For the rest of the day the scene was reminiscent of the King's Cup and *Daily Express* races of last year, and by mid-afternoon the race was postponed with the hope of better weather on the following day. However, in order that the crowds should not be too disappointed, demonstrations of formation flying and aerobatics were staged.

On Sunday the weather seemed even worse. Hopes of holding the race had almost faded when a break in the low cloud appeared and the rain temporarily ceased; and at 1650 hr the six competing aircraft were at the starting line (three of the original nine entrants had been unable to get through). The first man off was Mr. B. Snook in his Aeronca, G-AEVS, followed by a Tipsy B, G-AFSC, flown by Mr. H. Davies. These two were closely tailed by the old Cirrus Moth, G-EBLV, and the Avro Avian, G-ABEE, flown by W/Cdr. C. Pike, A.F.C., and Capt. A. Marshall respectively. David Ogilvy was next away in the V.A.C.'s Gipsy-powered Avro Club Cadet, G-ACHP, and the scratch man was of course, Mr. I. Forbes in his Miles Nighthawk, G-AGWT.

The race was flown over three laps of an 8-mile course. Lapping at 161 m.p.h. and aided by his steep pylon turns, it was Ian Forbes who swept past the finishing post to win the West London Trophy (and also to gain 12 points, putting him in third place for the Vintage Aeroplane Club Trophy, to be presented at the end of the year to the pilot gaining the greatest number of points during the season. Second machine home was G-EBLV, with a speed of 93.5 m.p.h., and the Avian came third at 95.5 m.p.h. The Tipsy, with a speed of 87 m.p.h., was fourth and, rather disappointing perhaps, the Cadet fifth, with a speed identical with that of the Cirrus Moth. The Aeronca, lapping at 73.5 m.p.h., finally crossed the finishing line to end the first air race of the season.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

Glory's Second Tour Ends

THE Light Fleet Carrier H.M.S. *Glory* (Capt. T. A. K. Maunsell) has completed her second tour of duty in Korean waters and is now on her way to the Mediterranean, after having been relieved by H.M.S. *Ocean*. She has been operating under the command of Capt. K. S. Colquhoun, D.S.O., Capt. Maunsell having assumed command only recently.

Since leaving Britain in January, 1951, *Glory* has steamed some 85,000 miles, made more than 6,400 aircraft launchings. She has been screened by over 60 destroyers coming from five different nations.

The carrier's two squadrons, No. 804, Sea Furies, commanded by Lt. Cdr. J. S. Bailey, O.B.E., and No. 812, Fireflies, commanded by Lt. Cdr. J. Culbertson, have flown some 4,835 operational sorties totalling 11,860 hours of flying time. In all, 27 aircraft have been lost and more than 140 damaged, but only 13 accidents were connected with deck landings. Lt. Whitaker, with 149, has the largest number of sorties to his credit, but 16 other pilots have flown more than 130 each.

The ship has suffered the loss of nine aircrew killed and one wounded, while 24 aircrew have been rescued from lost aircraft.

Ammunition expenditure over the period included nearly a million 20 mm cannon shells, 14,000 rockets and more than 3,000 bombs.

M.E.A.F. Small Arms Meeting

AN outcome of the first annual championships held at Fanara by the newly-formed M.E.A.F. Small Arms Association is that the Middle East will, for the first time, be represented at the R.A.F. S.A.A. annual meeting at Bisley, to be held in June. A selected M.E.A.F. Command team compiled a score of 1,185 points, which will count as the Command's score in the R.A.F. Command Challenge Cup competition.

The meeting included a hotly contested rifle match between the Army and the R.A.F. In the first phase (deliberate fire) the Army led by one point, and in the second phase (fire with motion) went ahead by another two points. In the third phase the R.A.F. reduced the lead to one point again, and in the final phase (snap shooting) emerged with a total of 300 points to the Army's 288. This gave the R.A.F. the victory, with an aggregate of 1,188 points to the Army's 1,177. The R.A.F. team was made up of: S/L. R. Carter (capt.), W/O. Farrell, F/S. Cleverly, Sgt. Richards, Cpl. Carter, Cpl. Elton, Cpl. Nutburn and L. A/C. Davies. S/L. Carter also captained the Fayid team.

The results of the other major events of the meeting were :—

Inter-Station Championship: 1, Fayid, 1,072 pts.; 2, Abu Sueir, 961 pts.; 3, Abyad, 958 pts.

R.A.F. Individual Rifle Championship: 1, Sgt. Richards (Fayid), 309 pts.; 2, F/S. Cleverly (El Firdan), 299 pts.; 3, S/L. R. Carter (Fayid), 289 pts.

M.E.A.F. Command Individual Rifle Championship: 1, Sgt. Richards (Fayid), 309 pts.; 2, F/S. Cleverly (El Firdan), 299 pts.; 3, S/L. Fenton (Aden Protectorate Levies), 298 pts.

Young Officers' and Airmen's Prize: 1, Cpl. Elton (Fayid), 149 pts.; 2, Cpl. Nutburn (Abyad), 134 pts.; 3, Cpl. Dancer (Abu Sultan), 133 pts.

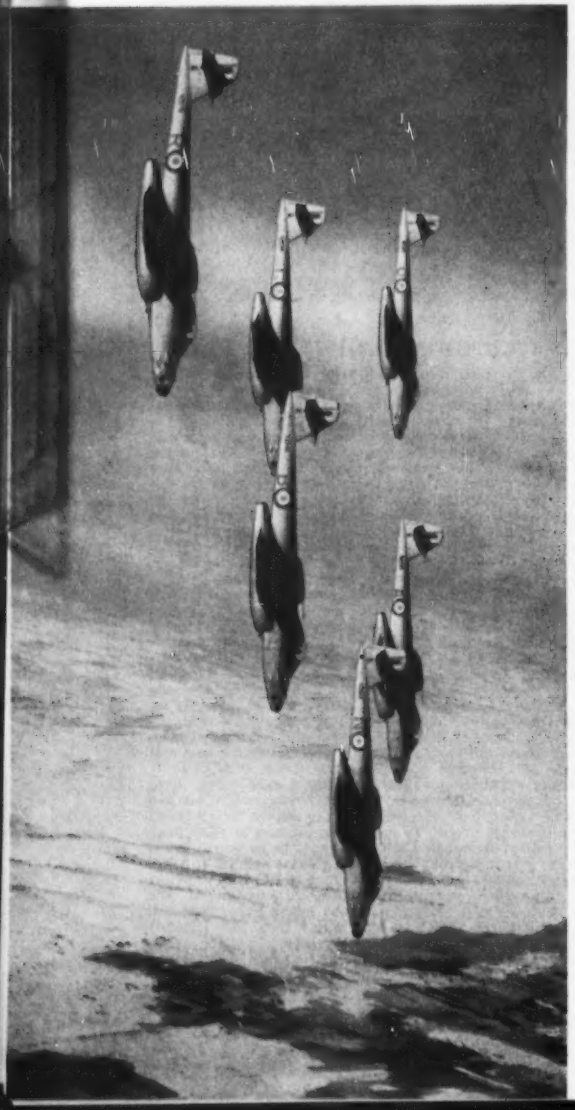
R.A.F. Regiment Squadron Championship: 1, No. 62 Rifle Squadron, 327 pts.; 2, No. 28 L.A.A. Squadron, 318 pts.; 3, No. 27 L.A.A. Squadron, 315 pts.

Light Machine-Gun Competition: 1, El Hamra, 123 pts.; 2, No. 29 L.A.A. Squadron, R.A.F. Regiment, 105 pts.; 3, Abu Sueir, 102 pts.

R.A.F. Egypt Revolver Championship: 1, Abu Sueir, 179 pts.; 2, Fayid, 138 pts.; 3, El Hamra, 125 pts.

At the conclusion of the meeting the C-in-C. M.E.A.F., Air Marshal Sir Victor Groom, presented the prizes.

The chairman of the M.E.A.F., S.A.A., is A. Cdre. J. E. R. Sowman, who is a former captain of the R.A.F. Inter-Service Twenty in the United Kingdom.



THUNDER IN THE EAST: Six Meteor F.R.9s of a certain famous M.E.A.F. squadron plummet earthwards as they ease out of a formation loop—dramatically recorded by an obliquely mounted reconnaissance camera in the nose of a similar aircraft.

R.N.Z.A.F. Sunderlands

THE first of the twelve reconditioned Mark 5 Sunderlands, which the Royal New Zealand Air Force is buying from Britain, is expected to be delivered in October next. These flying boats were sold by the R.A.F. at a nominal price, and New Zealand is paying for the reconditioning, which will be done by Short and Harlands.

A. V-M. D. V. Carnegie, the C.A.S. of the R.N.Z.A.F., has said that these Sunderlands will be equipped with the most modern radio installation. They will be delivered by R.N.Z.A.F. crews.

Freedom of Entry for No. 605

ON Saturday last the Freedom of Entry of the City of Coventry was conferred upon No. 605 (County of Warwick) Squadron, R.Aux.A.F. The presentation of the Deed of Privilege was made by the Mayor, Councillor Weston, to A. Cdre. J. A. Cecil Wright, the Honorary Air Commodore and one of the early commanding officers of the unit.

The ceremony was also attended by Lord De L'Isle and Dudley, Secretary of State for Air, Air Marshal Sir Basil Embry, A.O.C-in-C. Fighter Command, and Lord Willoughby de Broke, who is the Lord Lieutenant of Warwickshire and is also a former C.O. of the squadron.

A service was held on Sunday in the ruins of Coventry cathedral at which the Deed of Privilege was dedicated.

Yacht Club H.Q. Opened

TOMORROW, Marshal of the Royal Air Force Sir John Slessor is due to open the new headquarters of the R.A.F. Yacht Club at Riverside House, Hamble. He is expected to fly down from Northolt and will be met by the Commodore of the club, G/C. E. F. Haylock.

Naval Aviation Appointments

THE following appointments are announced by the Admiralty : Capt. F. H. E. Hopkins, D.S.O., D.S.C., is to become Deputy Director Air Operational Training, and Capt. R. B. N. Hicks, D.S.O., is to be Chief Staff Officer to the Flag Officer Air (Mediterranean). The first commanding officer of R.N. Air Station Brawdy on commissioning will be Capt. R. E. N. Kearney, O.B.E., while Capt. N. S. Henderson, O.B.E., is to take over the command of Bramcote.

AIRWORK *services Sabre-jets*

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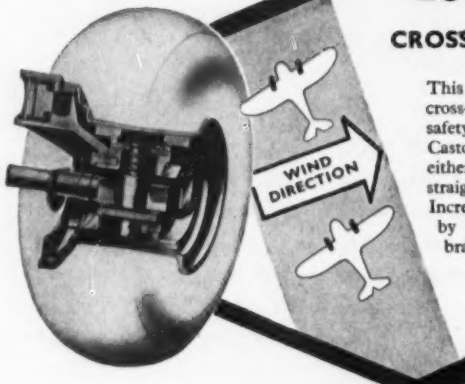
Developed through years of research and testing, Goodyear aircraft tyres are built to "take it" on touchdown. Resistant to heat, fatigue and bruising, built to stand up to the impact of weight multiplied by m.p.h., they assure safety at today's high landing speeds. The All-Weather Tread illustrated is one of the variety of aircraft tyres, designed to give maximum reliability under all conditions.



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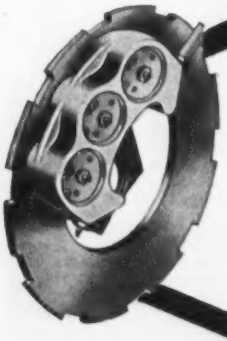

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FOR UTMOST RELIABILITY

SERVICE AVIATION . . .

In command of H.M.S. *Eagle*, in November, will be Capt. A. N. C. Bingley, O.B.E., and Capt. Peters, D.S.C., is appointed to H.M.S. *Implacable* in command as Flag Captain and Chief Staff Officer to the Commodore Training Squadron.

For exchange service with the Royal Australian Navy, Capt. D. Sanderson, D.S.C., is to command the new R.A.N. Air Station Schofields and act also as Captain (Air) New South Wales.

Equipment Director

AFTER more than two years in his previous appointment as S.A.S.O. to No. 41 Group Maintenance Command, A. Cdre. C. J. Nobbs is now Director of Equipment (C) at the Air Ministry.

Before going to No. 41 Group A. Cdre. Nobbs was Senior Equipment Staff Officer at H.Q. B.A.F.O. and during the war served in various capacities in the Directorate-General of Equipment.

Map Making in Africa

NOW starting on its sixth year of air survey in Africa, No. 82 Squadron, the only Avro Lancaster squadron left in Bomber Command, has photographed nearly 1,000,000 square miles of territory.

The work, which is to assist the Directorate of Colonial Survey, entails the production of the topographical maps necessary for various development schemes. These include the strategic railway link between East and Central Africa, irrigation projects in Basutoland, hydro-electric schemes in Rhodesia and West Africa and development of the agricultural and mineral resources of the territories generally. Most of the maps have to be to a scale as large as one inch to a mile.

A flight from No. 82 first started operations in West Africa in 1946 and since that time over 970,000 square miles have been mapped. At present the squadron, commanded by W/C. S. G. Wise, C.B.E., D.F.C., is engaged in East Africa and Basutoland. The main base is at Eastleigh, Nairobi.

During the period April-December, 1951, the squadron photographed nearly 170,000 square miles in Northern and Southern Rhodesia, Nyasaland and Tanganyika. Aircraft were based at Tabora, Livingstone and Dar-es-Salaam. They flew 631 photographic sorties, and averaged approximately 90 hours' flying per aircraft per month. Previously the squadron was in West Africa, where aircraft flew sorties totalling 3,358 hours, giving an average of just over 64 hours per aircraft per month.

In addition to difficulties arising from the great distances at which the Lancasters operate away from their main base, servicing is also complicated by unusual local problems. At a Middle East base it is said that a constant battle had to be waged against the local sparrows, which would sit on the dispersal fences, waiting for the Lancasters to taxi in. Immediately the airscrews had stopped, the birds would fly into any opening in the cowlings or fuselages in search of nesting sites. It was a race between the ground crews (to seal these openings) and the birds (to start nesting). The squadron's record-book admits that the ground crews did not always win—one morning a nest, with eggs, was found in an air intake of an aircraft which had landed at noon the previous day.

Another servicing complication occurred at Tabora, in Tanganyika. When the covers of an engine were removed it was discovered that a large swarm of bees had started to build a nest. In West Africa local tribesmen were deeply suspicious of a radar beacon set up as a navigation aid, which they regarded as a powerful "ju-ju." This problem was solved with the tactful assistance of Government officers.

TYPE 508 is the Supermarine designation of this remarkable twin-Avon carrier-borne intercepter, which was recently inspected by Rear Admiral E. M. C. Abel Smith, C.B., C.V.O., Vice-Admiral E. W. Anstice, C.B., Vice-Admiral Sir Michael Denny, K.C.B., C.B.E., D.S.O., and Major Sir Hew Kilner, M.C., managing director, Vickers-Armstrongs, Ltd. Very high speed and a quite phenomenal rate of climb are reconciled with a moderate landing speed by the use of leading-edge "droop-snoot" flaps (seen here) in conjunction with the trailing-edge flaps.

The Steam Catapult in U.S.A.

TRIALS in America with the new steam catapult on H.M.S. *Perseus* have been completed and the carrier, commanded by Capt. R. G. Poole, R.N., has returned to England.

The American tests included 140 launches of deadweights and carrier aircraft, and trials were also made using steam at higher pressures than those available in the *Perseus*. For this purpose steam was supplied by U.S.S. *Greene* and the catapult was found readily adaptable to the higher pressures obtained.

The trials have proved so successful that investigations have already begun into the possibility of installing the type in the flight deck of U.S.S. *Forrestal*, the new American flush-deck carrier. The first installation, however, will be made in the Essex-class carrier *Hancock*, which is now in dock for complete modernization, including strengthened decks and enlarged lifts to accommodate modern naval aircraft.

In adopting this new catapult—nicknamed by the Americans "the steam slingshot"—the U.S. Navy will make the modifications necessary for manufacture in America. Meanwhile, a "small initial quantity" will be ordered from Britain.

Details and photographs of the steam-operated catapult—which was invented by Cdr. (E) C. C. Mitchell, O.B.E., of Brown Brothers and Co., Ltd.—appeared in our issues of January 4th and 25th.

TWO APPOINTMENTS: A.V-M. A. C. Sanderson (left) who has been appointed to succeed Air Marshal Sir Frances Fogarty as A.O.C.-in-C. F.E.A.F., and G/C. Kingwell, the new Australian Air Attache in Washington.

R.A.F.A. Annual Report

IN his foreword to the Association's annual report, the chairman of the National Council of the Royal Air Forces Association, Air Marshal Sir Robert H. M. S. Saundby, draws attention to a 12.24 per cent drop in membership—despite the recruiting of 20,000 new members during the year.

"Wings Day," which was launched on a national basis, produced a total revenue of £26,620. After deducting national and local expenditure the net proceeds amounted to £18,584, which sum will be devoted entirely to welfare work.

The balance sheet reflects the difficult period through which all voluntary organizations are passing and shows, also, the care taken to conserve the Association's funds. Calculated on the same basis as the accounts for the previous year, the deficit is increased by £3,883 to a total of £29,250, but this takes no account of the proceeds from "Wings Day." A very considerable saving has been achieved by issuing the journal *Air Mail* bi-monthly instead of monthly as hitherto. During the year £10,000 was received from the Air Council, and the Society of British Aircraft Constructors made a donation of £1,000 from the proceeds of the S.B.A.C. Display at Farnborough.

In the twelve months under review 29 new branches have been formed, several small ones closed and others amalgamated. At the end of the year the total number of branches operating was 774.

FILLING A GAP

Aircraft Sealants and Adhesives: Products of a Pioneer Firm

Mr. D. E. Cameron, M.A., the chairman and managing director of the B.B. Chemical Co., Ltd., makers of "Bostik". His father was a founder of the company.

WHEN a proprietary product becomes so well established that its users write and think of its name as being spelt with a small initial letter, as though it were soap, or glue, or sealing-wax, then its manufacturers may consider themselves complimented. Nevertheless, most firms are understandably sensitive about the use of the registered trade names they employ, and just as their customers would resent being spelt jones or robinson, so do they rightly insist upon a capital, and usually in quotation marks as well.

"Bostik," the principal brand-name of the B.B. Chemical Co., Ltd., of Leicester, and one so familiar in the aircraft industry (and many others), is a case in point. Oddly enough, this preparation now so intimately connected with wings and wheels owes its inception to welts and walking. Fifty years ago, when the company was founded as the Boston Blacking Co., it specialized in adhesives for the boot and shoe trade, who demanded (then as now) high standards of strength-plus-flexibility. This industry still takes a large proportion of the B.B. Chemical Company's products, particularly some "high-speed" adhesives which hold the internal economies of shoes in correct relation while they are assembled on automatic machines.

But here we are concerned only with the aircraft industry, which in the middle 1930s began to discover the virtues of the sealants and adhesives that the company had started to develop for such purposes as window-fitting and attaching treadways to wings. (It was when a representative of the Boston Blacking Co. called on an aircraft firm and was greeted with, "Thanks, but our employees clean their own shoes," that it was decided to change the company's name—or so the story goes!)

Watertight Roofs

When canopied aircraft began to come into general Service use in the years immediately before the war, the demand for "Bostik" glazing compound soared. Lord Rothermere's Bristol monoplane, *Britain First*, and the Avro 652 (respectively precursors of the Blenheim and Anson) used it, and so did the Short Singapore, A. W. Whitley, Supermarine Walrus, Blackburn Shark, and Vickers Wellington. It was employed on the high-altitude Bristol monoplane and on Alex Henshaw's racing Mew Gull, while the first use of "Bostik" tank sealant was in the multiple wing-tanks of the upper component of the Short-Mayo Composite.

It is the makers' claim that once war production was under way their products were used on every single British military aircraft. In one application alone, that of adhesives for self-sealing tanks, *nearly* 1,400 *tons* was supplied during the peak year of 1944. In this particular application, use was made of a self-vulcanizing rubber adhesive which united a priming coat on the tank exterior to the first layer of the surrounding rubber envelope. The adhesive was required to hold the envelope securely to the primed metal surface, yet allow it to loosen sufficiently round a puncture or exit-wound to permit the petrol to swell the envelope and seal the hole; at the same time, the remainder of the envelope had to remain unaffected by the petrol.

The company's sealants were (and are) used in the maintenance of aircraft as well as in their manufacture. In 1942, for example, Bomber Command had a number of bombers grounded through water entering their fuselages and putting the electrics out of action; and order was forthwith given for the trouble to be cured on the stations by generous application of "Bostik."

Today a considerable proportion of the aircraft industry's orders for "Bostik" grades, apart from glazing, are used in the sealing of pressurized fuselages. The 1751-3 series, for instance, are brushed on between overlapping skins before riveting; Grade 1790 is extruded into the angular joints formed at skin overlaps, butt straps, stringers, ribs, and similar intersections; and rather similar methods are used for the joints of integral fuel tanks. Though the procedures are straightforward, it is important that they should be correctly performed, and carefully detailed instructions are made available.

Another application—this time with "Boscoprene" 2413/1 and 3 cement—is for attaching de-icer shoes to metal airscrew blades. This self-vulcanizing cement is one which gives an extremely strong bond, even of metal to metal. It is packaged in two parts, one incorporating a curing agent (e.g., sulphur), and the other an "accelerator," and the two solutions are mixed just before use. The mixture is applied over a primer that keys it to the metal, and self-vulcanization begins at once.

Of what do such curiously efficient compounds consist? We satisfied our curiosity on this point during a recent visit to the Leicester factory. Very briefly, their basis is raw natural rubber or, if high petroleum-resistance is required in the finished product, synthetic rubber. After careful selection and testing, the rubber is "masticated" in powerful mills, formed into thin sheets between heated rollers, then introduced to its solvent, which may be petroleum or (again according to the ultimate requirement) any one of a number of liquids of strange names and stranger odours. The introduction is effected in company with a filler (e.g., carbon black or zinc oxide) which will give body and toughness to the finished product, and resins are added to give the required degree of "tack." In every case mechanical mixing is used: the largest machines require 50 h.p. to stir the formidable-looking dark grey mass within the 500-gallon mixing-chambers.

The various blends are piped across to the filling shops, where under a moderate head of air pressure they are filled into tins on conveyor-belts; or some go into outsize toothpaste-tubes, filled automatically by a fascinating machine that squirts in the charge through the open bottom end of each tube, which it then wraps over and crimps securely.

Other individual packaging takes the form of cartridges for insertion into pneumatically operated applicator-guns (there is a range of applicators and pressure-fed brushes and an endless variety of nozzles to extrude "Bostik" in every imaginable section, thick or thin). Yet another method is applied in the case of "Prestik," a comparatively new product designed as an adhesive filler, which permanently remains slightly plastic, for large gaps; here the compound is extruded in continuous lengths (flat, round or in special sections) sandwiched in a drum-wound "Cellophane" film 3in wide. This process, like several of the others, is performed on machines designed and made by the company.

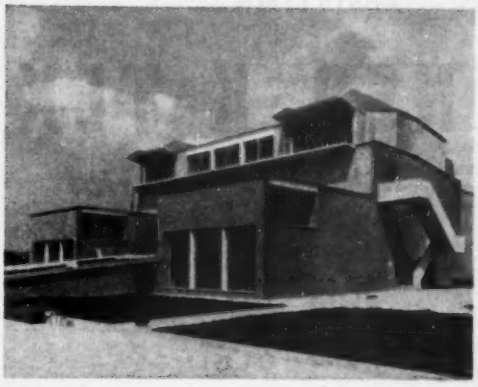
Today, some 560 workers are employed in the factory, which covers seven acres. It is controlled by five executives: Mr. D. E. Cameron, M.A., chairman and managing director since 1939; Mr. R. Defries, F.R.I.C., M.I.I.A., vice-chairman and assistant managing director; Mr. H. C. Hyde, purchasing director; Mr. L. E. Puddefoot, B.Sc., technical director; and Mr. J. L. Cowdell, sales director. They are clearly proud of the highly specialized contribution they have been able to make to the aircraft industry, as to many others.

R.C.

FORTHCOMING EVENTS

May 10. Exeter Aero Club: Display.
May 10-11. l'Association des Amis de l'Aumôneries de l'Air: Rally.
May 11. Rochester Flying Club: Navigation Competition.
May 17. Wolverhampton Aero Club: Goodyear Trophy Race and Display.
May 18. Northamptonshire Aero Club: At Home, Sywell.
May 21. Aircraft Recognition Society: Contest, London.
May 22. Aéro-Club du Dauphine: Air Meeting, Grenoble.
May 23. Aircraft Golfing Society: Annual Dinner.
May 25. Aéro-Club de France: Coupe Stamm (helicopters).
May 25. Ragosine-Auster Trophy Navigation Competition, Rearsby.
May 29. R.Ae.S.: Fortieth Wilbur Wright Memorial Lecture: "Prophecy and Achievement in Aeronautics," by Sir Harry M. Garner, C.B., M.A., F.R.Ae.S.
May 30-June 2. Model-flying team contest, Belgium v. Great Britain, Namur.
May 31-June 2. Aero-Club de Cannes: International Rally.
June 2. S.S.A.F.A.: Air Display, Yeadon, Leeds.
June 2. Midland Aero Club: Display, Elmdon.
June 4-14. Third Mechanical Handling Exhibition, Olympia, London.
June 7-8. Yorkshire Aeroplane Club: International Invitation Rally.
June 8. R.A.F. Golfing Society: Match v. Air Ministry G.S.
June 14. Girl Guides Association: Air Ranger Flying Pageant, Sywell Northampton.
June 14. Auster Flying Club: Rally, Rearsby.
June 14. London Aeroplane Club, Vintage Aeroplane Club and Herts Auto and Aero Club: At Home, Panshanger.
June 14-15. Aéro-Club de Charente Maritime: Pons Rally.
June 15. R.Ae.S. Garden Party, White Waltham.

*Turbo-jet test plant at BRISTOL...



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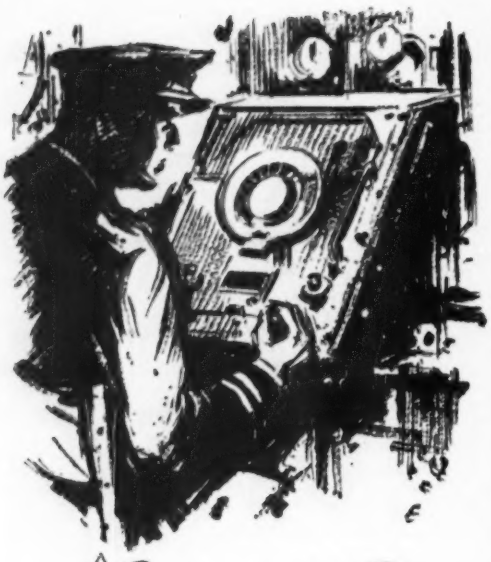

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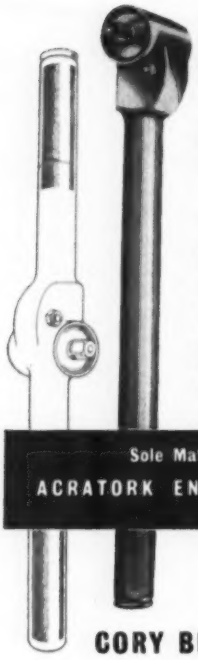

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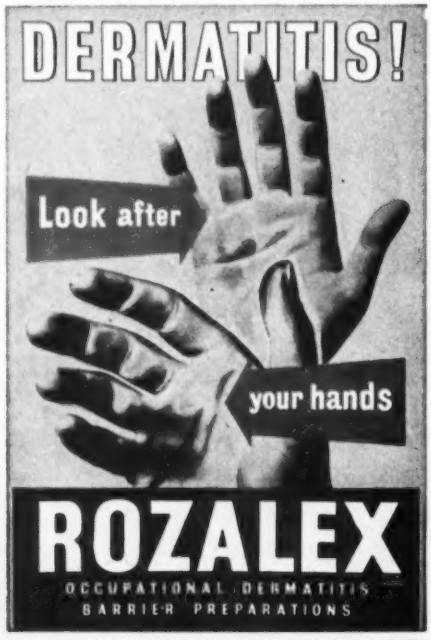

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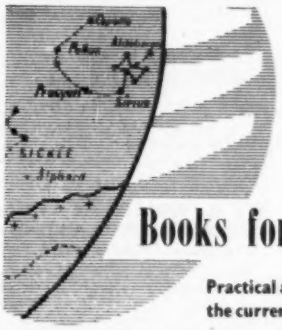

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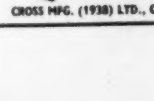

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AIRCRAFT weight engineers required by Saunders-Roe, Ltd., East Cowes, Isle of Wight. Seniors and juniors required for expansion of an enterprising department. Experienced men, and young men looking for an interesting career are invited to apply, giving details of experience, age, salary expected, etc., to the Cowes Office of the Ministry of Labour and National Service. [7967]

FLYING instructor required for basic flying training school at Sywell. Applicants must have held C.F.S. Category and be on the R.A.F. Reserve, or be prepared to join.—Applications stating age, qualifications and details of experience should be made in writing to The Manager, Brooklands Aviation, Ltd., Sywell Aerodrome, Northampton. [8045]

DESIGN draughtsman required by Lockheed Hydraulic Brake Co., Ltd., Leamington Spa. Should be fully experienced in light mechanical engineering. Knowledge of hydraulics an advantage. Opportunity for early promotion to Section Leader grade on proof of ability. Single hostel accommodation available.—Apply: Employment Exchange. [8061]

LEADING aircraft company in the London area requires senior aerodynamicist with 1st or 2nd class Hons. Degree and four or five years' experience in similar capacity. Housing accommodation available to selected applicant.—Write, stating age and full particulars, to Box AC72156, Samson Clarke, 57/61, Mortimer Street, W.1. [8065]

SENIOR designer for aero-engine gas-turbine project design required in well-known firm in London area. Previous experience on mechanical design is essential. Good prospects of promotion for a suitably experienced and enterprising candidate.—Please write, stating full details of age, experience and qualifications and salary required, quoting reference ACJ to Box 8847. [8084]

DRAUGHTSMEN required for aircraft and armament drawing office of Saunders-Roe, Ltd., East Cowes, Isle of Wight. Senior men with aircraft experience and juniors with aircraft or engineering background are invited to apply, giving details of experience, age, salary expected etc., to the Cowes Office of the Ministry of Labour and National Service. [7988]

TECHNICAL sales representative. Vacancy arises through expansion, by manufacturers of accessories used throughout aircraft industry. Applicants must possess sound aircraft engineering background, both practical and academic, to enable him, after training, to sell to technicians and designers. Good education, personality and definite interest in selling career are also essential qualifications. Must reside in or near London. Salary £500/£600 p.a., plus commission, about £220 p.a. or up, plus expenses. Car allowance or company car supplied. Pension scheme. This post is permanent and present staff have been advised.—Full details in complete confidence to Box 8811. [8077]

BRITISH EUROPEAN AIRWAYS are seeking to build up a staff of good tradesmen, men who are looking for steady employment with good rates of pay and conditions. Immediate vacancies exist for radio mechanics, airframe fitters/riggers, engine fitters, instrument mechanics and electricians. Basic rate 3s. 6d. per hour plus incentive bonus or time-workers' bonus; up to 3d. per hour proficiency pay can be earned; shift premium payments where appropriate. 44-hour week. After qualifying periods, excellent pension, insurance and sick pay schemes, two weeks' paid annual holiday, air travel concessions.—Applications, giving full information, initially in writing to Personnel Officer, B.E.A., Northolt Base, Ruislip Middlesex. [8060]

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ROCKET motor installations. Keep abreast of the latest developments. Aircraft draughtsmen and stressmen required immediately for new development and research work on rocket motor and gas turbine power plants. Good staff facilities.—Apply Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. Tel.: Edgware 3211. [7969]

AIR FORCE. Naval civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd., Luton Airport, Beds. Applications are invited from senior and junior draughtsmen, and stressmen for work on this interesting programme.—Write, giving details of experience and salary required, to Manager, Ministry of Labour and National Service, Luton, Beds. [7995]

APPLICATIONS are invited from senior and intermediate design draughtsmen. Experience of aero-engine design desirable, but not essential. Also checkers.—Please write, stating age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [8000]

TECHNICAL assistant required by Purolator Filters Division of Automotive Products, Ltd., Leamington Spa. Technical training to H.N.C. standard and knowledge of petrol and diesel engine design, experimental and research experience would be desirable. Familiarity with filtration problems an advantage.—Write Personnel Officer, giving full details of age, training and experience, salary. [8001]

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.—Applications should state full particulars of experience and qualifications and should be addressed to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [8032]

AIRWORK, Ltd., require flying instructors for service in the north of England. Applicants should have had previous R.A.F. elementary instructing experience and should be in possession of a minimum B.1 instructors category.—Apply in first instance to Manager, Flying Training Division, Airwork, Ltd., Sutton Lane, Langley, Slough, Bucks. Envelopes to be marked "Flying Training." [8036]

A TECHNICAL writer required by firm in N.W. London area manufacturing aircraft electrical equipment. Applicants must have concise style and be capable of compiling technical specifications from data or drawings. Electrical knowledge essential. The position is superannuated and gives considerable scope to an ambitious man with adequate experience.—Write, stating experience, age and salary required to Box 8351. [8055]

PROCESS engineer required in connection with production of complex high tensile steel components. Must be capable of design, development and layout of new plant. Preferred experience would include production engineering of aircraft fittings, application of high frequency heating, steel foundry plant, materials-handling equipment. Applicants should have served apprenticeships in engineering and qualified to H.N.C. standard.—Apply to Ministry of Labour for submission to The Personnel Manager, The Fairey Aviation Co., Ltd., Hayes, Middx. [8030]

NORMALAIR, Ltd., require for their London Office, first-class design and detail draughtsmen, experienced in light mechanical precision engineering or instrument practice and with aircraft background for aircraft pressurising and high altitude breathing equipment. Good working conditions and superannuation.—Apply, stating age, experience, qualifications and salary required to Employment Exchange (N.A.), Yeovil, Somerset. [7989]

SENIOR production engineering draughtsman required with considerable experience in design of plastic moulding dies and also of injection machines and hydraulic machinery for expanding application of now processed metalling wide variety of engineering problems. Good prospects. Pension scheme.—Apply to Ministry of Labour for submission to The Personnel Manager, The Fairey Aviation Co., Ltd., Hayes, Middx. [8038]

SENIOR technical assistant required for the Service Department of The de Havilland Engine Co., Ltd., preferably with experience on reciprocating and gas-turbine engines. Suitable applicant will be required to work on headquarters' staff of the Service Department at Leavesden Aerodrome, near Watford, Herts.—Apply in writing, stating age, qualifications and salary required, to the Personnel Officer, The de Havilland Engine Co., Ltd., Leavesden Aerodrome, nr. Watford, Herts. [7948]

BRITISH EUROPEAN AIRWAYS require for aircraft maintenance engineers holding "A" and "C" licences for Dakota and/or Viking aircraft. Knowledge of turbine engines and/or foreign languages an advantage. Successful applicants will be based at Northolt or London Airports and will be required to undertake temporary duty at outstations in the U.K. and on the Continent. Salary scale £10 10s. to £13 10s. per week, exclusive of allowances when abroad.—Apply in writing to Personnel Manager, B.E.A., Keyline House, Ruislip, Middlesex. [8009]

TOOLROOM foreman. A toolroom foreman is required by firm in the west of Scotland engaged in the light engineering industry. Applications are invited from qualified persons with a sound engineering background. A wide knowledge of jig and tool design and the ability to control staff are essential. The appointment will carry an attractive salary and is covered by Contributory Pension Scheme.—Applications, stating age and full details of experience will be treated in strict confidence, address to Box 8023. [8060]

ROLLS-ROYCE, Ltd., Glasgow, require senior and junior technical assistants for work on technical production and quality engineering. Applicants should have engineering degree or equivalent with previous experience in a similar type of work. Salary will be in accordance with experience and qualifications. Prospects of advancement good.—Applications should be made in writing to the Personnel Manager, Rolls-Royce, Ltd., Hillington, Glasgow, S.W.2, giving full particulars of experience, qualifications, etc. [7992]

ENGINEER required to take charge of a section engaged on research in connection with airborne receivers by Marconi's Wireless Telegraph Co., Ltd., Chelmsford. An attractive salary will be offered to a suitable applicant, who must have had good experience in this field. The position is one of responsibility and is permanent. Pension scheme, etc.—Please write in confidence, giving full details and quoting reference 875A, to Central Personnel Services, English Electric Co., Ltd., 24/30 Gillingham Street, London, S.W.1. [8027]

YOUNG engineer required to help start and eventually take over a section for test and development work on cordite or gas-operated motors. Applicants should have attained at least Higher National Certificate standard. Previous experience with cordite systems and similar units, such as starter motors and a knowledge of test bed procedure is desirable.—Applications stating age, experience and qualifications should be sent to the Chief Designer, British Messier, Ltd., Cheltenham Road East, Gloucester. (Terms of Notification of Vacancies Order 1952 apply to this advertisement.) [8044]

LICENSED pilot required for aircraft used on development and assessment of instruments by manufacturers in the West Country. Endorsement required for Viking or Valetta and lighter types, together with instrument rating. Approval by M.o.S. as test pilot an advantage. Preference given to applicant with sound engineering background so that he may interest himself in the equipment under test, and ultimately be appointed to sales or engineering divisions of the company. Age about 30, with 1,500-2,000 hours' flying experience. Salary according to qualifications and experience.—Write: Aviation Divisional Engineer, Smiths Aircraft Instruments, Ltd., Bishops Cleeve, Cheltenham. [8074]

PRESS shop foreman wanted by modern sheet metal factory in North Midlands. The equipment in the press section comprises double-action mechanical, triple-action hydraulic, and single-action crank presses, up to 500 tons capacity. The production embraces a wide variety of very high-quality pressings, many of which are in special materials. Small batch quantities necessitating frequent set-up changes are involved. Duties will include supervision of production, introduction of improved methods and the pursuit of a systematic policy of increasing press utilization. This is a well-paid staff appointment and the conditions of employment are attractive. Only men with considerable experience (including some experience on supervision) should apply. Age preferably but not necessarily under 45.—Write, giving details of age, experience, qualifications and salary required, to Box 8881. [8093

SITUATIONS WANTED

COMMERCIAL pilot, 26, singles experience only, studying for instrument rating, requires work in U.K. or abroad after end of May.—Box 8812. [8069

COMMERCIAL Pilot, with R/T Licence and 9,450 hours, seeks position, home or abroad, aged 41; good record.—Box 8845. [8082

ALT Pilot; Rapide, Dakota, Tudor, others; mainly air schedules; seeks introduction company contemplating Heron schedules; alternatively Dove.—Box 8846. [8083

2250 HOURS. Senior commercial licence, I.C.A.O. standard, endorsed DC-3, PBY-5a, Catalina, Goose, Sea Otter, Widgeon Y, and Grumman Goose. Age 27. Seeks position outside U.K.—Box 8813. [8073

PILOT, A.L.T.P., R/T, and instrument rating, requires permanency. 4,600 hours, 3,300 in command. Administration and foreign liaison experience.—For further details please write to Box 8826. [8077

CHIEF Inspector, A.M.I.E.I., welding, stressing, m/c. a/c. components, tubular fabrication, treatments. Technical writer. Widely travelled as technical adviser and sales. High-level recommendations of experience.—Box P.P.8826. [8078

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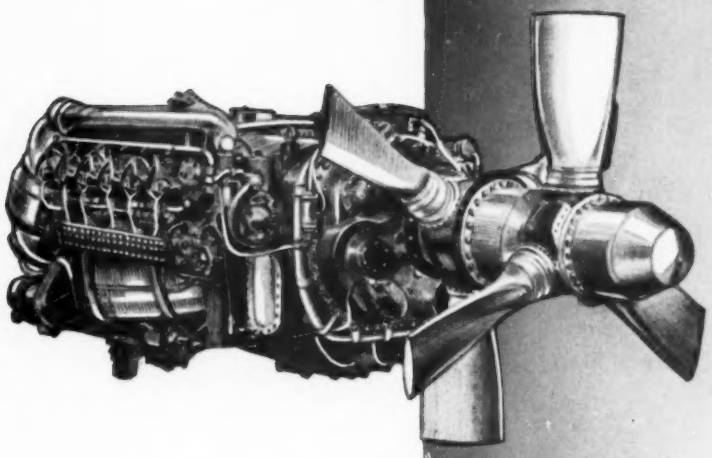

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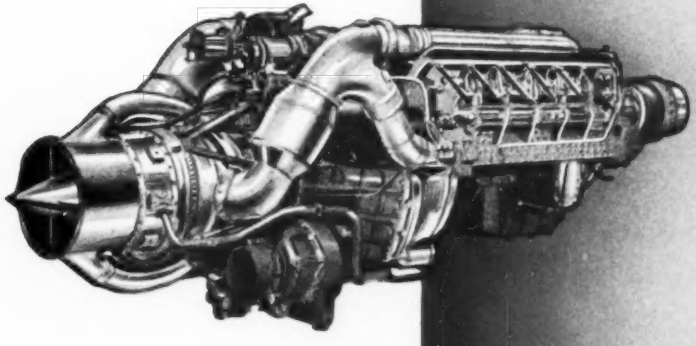

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